THE

BOTANY OF BIHAR AND ORISSA

An Account of all the Known Indigenous Plants of the Province and of the Most Important or Most Commonly Cultivated Exotic Ones

With Maps and Introduction

By

H. H. HAINES, C.I.E., F.C.H., F.L.S.

Late Conservator of Forests, Bihar and Orissa

Published under the Authority of the Government of Bihar and Orissa

IN SIX PARTS

PART I - 3

LONDON

PRINTED BY ADLARD & SON & WEST NEWMAN, LTD.

And Sold by the Agents for Indian Official Publications

1925

Price Rs. 8.

[Ag]ents for the Sale of Books Published by the Bihar a[nd] Orissa Government.

Agents in India.

[(1)] Messrs. Thacker, Spink & Co., Calcutta.

[(2)] Messrs. W. Newman & Co., Calcutta.

[(3)] Messrs. S. K. Lahiri & Co., College Street, Calcutta.

[(4)] Messrs. R. Cambray & Co., 6 and 8-2, Hastings St., Calcutta.

[(5)] Messrs. Thompson & Co., Madras.

[(6)] Messrs. D. B. Taraporevala, Sons & Co., 103, Meadow Street Fort, Post Box No. 18, Bombay.

[(7)] Messrs. M. C. Sircar & Sons, Harrison Road, Calcutta.

(8) Proprietor of the New Kishore Press, Lucknow.

(9) Messrs. M. N. Burman & C[o.], Bankipore.

(10) Babu Ram Dayal Argarwa[l], 184, Katra Road, Allahaba[d].

(11) Standard Literature Co., Lt[d.], 13-1, Old Court House S[treet], Calcutta.

(12) Manager of the Indian Sch[ool] Supply Depôt, 309, B[ow] Bazar Street, Calcutta.

(13) Messrs. Butterworth & C[o.], Ltd., 6, Hastings Stre[et], Calcutta.

(14) Messrs. Ram Krishna & So[ns], Anarkali Street, Lahore.

Agents in the United Kingdom.

[(1)] The High Commissioner for India (General Dept.), 42, Grosvenor Gardens, London, S.W. 1.

[(2)] Messrs. A. Constable & Co., Ltd., 10, Orange St., Leicester Square, London, W.C. 2.

[(3)] Messrs. Kegan, Paul, Trench, Trübner & Co., 68-74, Carter Lane, London, E.C. 4, and (Oriental Department) 39, New Oxford Street, W.C. 1.

[(4)] B. Quaritch, Ltd., 11, Grafton Street, New Bond Street, London, W. 1.

[(5)] Messrs. P. S. King & Son, 2 and 4, Great Smith Street, Westminster, London, S.W. 1.

[(6)] B. Blackwell, Ltd., 50, 51, Broad Street, Oxford.

[(7)] Messrs. Deighton Bell & Co., Ltd., Trinity St., Cambridge.

(8) Messrs. Henry S. King & C[o.], 65, Cornhill, London, E.C.

(9) Messrs. Grindlay & Co., [54], Parliament Street, Lond[on], S.W. 1.

(10) Messrs. W. Thacker & C[o.], 2, Creed Lane, Ludgate H[ill], London, E.C. 4.

(11) Messrs. Luzac & Co., 46, Gre[at] Russell St., London, W.C.

(12) Messrs. Oliver & Boyd, Twee[d]dale Court, Edinburgh.

(13) Messrs. E. Ponsonby, Lt[d.], 116, Grafton Street, Dubl[in].

(14) T. Fisher Unwin, Ltd., [1], Adelphi Terrace, Lond[on], W.C. 2.

(15) Messrs. Wheldon & Wesl[ey], Ltd., 28, Essex St., Lond[on], W.C. 2.

(16) East and West, Ltd., 3, V[ic]toria St., London, S.W. 1.

Agents on the Continent.

[(1)] M. Ernest Leroux, 28, Rue Bonaparte, Paris, France.

[(2)] Martinus Nijhoff, The Hague, Holland.

(3) Messrs. R. Friedländer & Soh[n], Carlstrasse 11, Berlin, N.W., Germany.

(4) Otto Harrassowitz, Leipzi[g], Germany.

THE

BOTANY OF BIHAR AND ORISSA

AN ACCOUNT OF ALL THE KNOWN INDIGENOUS PLANTS OF THE PROVINCE AND OF THE MOST IMPORTANT OR MOST COMMONLY CULTIVATED EXOTIC ONES

WITH MAPS AND INTRODUCTION

BY

H. H. HAINES, C.I.E., F.C.H., F.L.S.

LATE CONSERVATOR OF FORESTS, BIHAR AND ORISSA

Published under the Authority of the Government of Bihar and Orissa

IN SIX PARTS

PART I-3

LONDON

PRINTED BY ADLARD & SON & WEST NEWMAN, LTD.

And Sold by the Agents for Indian Official Publications

(*For list see previous page*)

1925

Price Rs. 8.

DATES OF PUBLICATION.

Part				
Part	I,	pp. i–x and pp. 1–199	.	1925
„	II,	pp. 1–224	.	1921
„	III,	pp. 225–418	.	1922
„	IV,	pp. 419–754	.	1922
„	V,	pp. 755–1058	.	1924
„	VI,	pp. 1059–1350	.	1924

Made and printed in Great Britain.

TO

SIR EDWARD ALBERT GAIT, K.C.S.I., C.I.E., I.C.S.

LIEUTENANT-GOVERNOR OF BIHAR AND ORISSA

(1915–1920)

WITHOUT WHOSE ENCOURAGEMENT THIS WORK COULD NOT HAVE BEEN WRITTEN,

IT IS RESPECTFULLY INSCRIBED WITH GRATITUDE AND AFFECTION

PREFACE.

An apology is necessary for the sub-title of this book, as large groups of plants of which very little is known in Bihar and Orissa, viz. the algæ (including *Characeæ*), fungi and *Muscineæ*, have not been touched upon. Among the higher plants very much still remains to be done before the botany of the province can be regarded as worked out, even in the very narrow sense of all the species being known. The basis of the book is my own notes and collections,* and the duties of a forest officer in India leave so little time for the pursuit of botany that not only have interesting plants been frequently observed which there has been no time to collect, but often specimens collected have become useless, and had to be thrown away while awaiting opportunity for examination or drying. In some cases, especially on my only visits to special localities, such as the Mayurbhanj Mountains and the Orissa delta, the quantity of drying paper carried has proved insufficient to cope with the new material. Finally, some districts, including many of the native states, have not been botanized at all. There is, therefore, plenty of even ordinary field work remaining to be done by those who take an interest in the natural history of plants, and for anyone with a settled residence and a garden, where doubtful species and varieties could be cultivated and watched, the field is practically unworked. Perhaps the largest collector of herbs in the province has been C. B. Clarke, who, in addition to good specimens, has frequently supplied accurate drawings and valuable notes. Clarke collected chiefly (so far as our province is concerned) in Chota Nagpur. He more especially appears to have turned his attention to the rice field flora. Next to Clarke in the extent of his collections in the province was the distinguished biologist Buchanan-Hamilton. In 1801–02 he went by river to Patna, and then marched through Saran and Tirhut to Nepal,† but of more importance than this was his long residence in our Northern tract, commencing in 1809 and continuing with short breaks to 1812–13, during which time he was engaged in the statistical survey of Purneah, Bhagalpur (as it then was), Monghir (or Monghyr, Mungger of his MS.), Patna and Shahabad. The collections of Buchanan-Hamilton, which include woody plants as well as herbs, are well represented in the Wallichian Herbarium at

* The sign ! after a locality, without the addition of a collector's name, indicates specimens seen by me *in situ*.

† "Sketch of the life of Francis Hamilton (once Buchanan)" by Sir D. Prain in the *Annals of the Royal Botanic Garden, Calcutta*.

Kew, where I have had the opportunity of consulting them, though want of time prevented my going through them systematically until I had nearly completed the Flora. A complete set of Hamilton's collections from 1807–1814 are said to be represented in the Herbarium, but this seems scarcely credible, as, with the exception of the Monghyr district and the country around Nathpur, the flora of the Bihar and Orissa districts is poorly represented, and of numerous plants alluded to in the manuscripts there are often no specimens.* The results, therefore, of this examination have been disappointing. They have been shown in Appendix I. The manuscripts of Hamilton are in the India Office Library, but interesting as they are, the plants mentioned are for the most part under their vernacular names. Occasionally the technical name is given, or they are referred to the species described in Rheede's *Hortus Malabaricus*, or other data are given which sufficiently determine the species. But as the value of a provincial flora is greatly discounted by being spread over a large number of years, I have not thought that the advantage to be gained by identifying all these references would be commensurate with the time which would have to be spent on them. In the case of Monghir, of which the flora is most completely described, and of which I myself have not close acquaintance, the gist of Hamilton's account is given in the Introduction. The important collection from Manbhum of the late Rev. Dr. Campbell I particularly noticed in the *Forest Flora of Chota Nagpur*, and I have not been able further to visit it, though many duplicates of Campbell's in the Kew and Calcutta Herbaria have been made use of. A small collection, but containing nevertheless some records not found elsewhere, was made in the province by Sir J. D. Hooker. Hooker entered it at the boundary of Burdwan and Manbhum, and marched along the Grand Trunk Road, ascending Parasnath *en route*, through parts of Manbhum, Hazaribagh and Gaya to the Sone. He then passed over the Kymore Hills (Shahabad district) and dropped down the Ganges to Caragola ghat (in a boat, so that very few specimens are available from this part of the route). He then proceeded through Purneah, leaving the province at Titalyah, for his celebrated Himalayan tour. The collections of Kurz were made chiefly along the Ganges and in Behar—an unfortunately vague term which has been used in various senses, and used to include the northern half of Chota Nagpur as well as most of the area between Chota Nagpur and the Ganges, as in the map attached to the *Flora Indica* of Hooker & Thomson.† Where Behar is given on the tickets of specimens collected by Kurz or others

* To take a concrete instance, Hamilton's No. 2093, "*Phyllanthus sanphalia*," which was collected in Monghyr and has been seen by Col. Gage at Edinburgh, is not in the Wallichian Herbarium.

† The province of "Bahar" (Behar) in the *Description of Hindostan* by Walter Hamilton (1820) embraced the province of Bihar and Orissa as now constituted without Purneah, Singbhum, Sambalpur, or any part of Orissa. Then again there was also a district of "Bihar" which also fluctuated in area, at one time embracing all of what is now known as Gaya, as well as parts of Shahabad, Patna, and a piece of the old district of Ramgarh (now in Hazaribagh). Buchanan-Hamilton's account of Bihar and the city of Patna is applicable to the present Gaya and Patna.

without further information being available it is so mentioned in the Flora, otherwise the term has not been used. In this connection it might be observed that the word "Orissa" as used in botanical works does not necessarily refer to the Orissa as at present understood. The term as used by Hooker and Roxburgh included all Madras north of the Godaveri, and it appears in a few cases to have been used in this wider sense in *Bengal Plants*, some of the specimens recorded as being from Orissa having been collected by Cleghorn and others south of the present political boundary. Gamble and Wood, who collected in Chota Nagpur, Lace, who collected in Orissa, Hope in Behar, Griffith in Sambalpur, Hieronymus in Champaran, and the Rev. Father Cardon, who collected orchids in Chota Nagpur, are among other botanists whose collections from our province are represented to a smaller extent in the herbaria at Kew and Calcutta. There are also a few specimens collected by Thomson, Anderson and Prain, but a considerable number of specimens, chiefly grasses, were collected by Nusker and Mokim—collectors sent out by Prain while Director of the Botanical Survey. These were chiefly from the Santal Parganas, Monghyr and Gaya. With the exception of Gamble and Lace, and to some extent Hamilton, the botanists mentioned above chiefly confined their attention to the more cultivated parts of the province. Both duties and inclination have led the author into the wilder and least cultivated regions. Camping wherever possible within the forest itself, and when the evening's office work would permit, walking out again after the labours of the day with a rifle as sole companion, his opportunities for nature study have been of a kind complementary to those of most of his predecessors in the botanical field, and there is scarcely an indigenous species of tree or shrub described in the Flora which he has not personally noted in its own habitat. On the other hand the writer's herbarium is exceedingly deficient in the flora of the open country and in that of the jheels and tanks, as well as in epiphytic orchids, the collection of which entailed more time than could be given. In addition to tours in all the Government forests of the province, the author has visited, either on special duty, or on behalf of private owners, or during short periods of leave, the forests of Champaran, a small part of Shahabad, part of the remaining jungles of Purneah and of Gaya, many of the states of Orissa, and the mangrove swamps of the Mahanadi delta. Before leaving India he spent some five months examining the collections in the Sibpur Herbarium at Calcutta.

Adverting shortly to the scheme of the book: in the body of the Flora, for the convenience of those accustomed to the usual English systematic works, the *Genera Plantarum* has been mostly followed in the sequence of the families of the Angiosperms. In the Introduction there is an alternative system of classification, supposedly more natural, and also descriptions of the larger groups as well as a general conspectus of families. This classification is based on various authorities (especially Jussieu, De Candolle, Lindley, Endlicher, Hooker, Arber, Parkin and Scott), and is an elaboration of that in the *Forest Flora of Chota Nagpur*, which it has been understood has been found useful, and assists students, in some cases, to determine the family of a

plant whose affinities are less obvious from the arrangement in the Flora.

There has been no attempt at uniformity in the descriptions. These vary in detail according to the necessities of the case, and the treatment of species is very unequal. In general an endeavour has been made to adopt the arrangement used by Sir J. D. Hooker in his *Students' Flora of the British Islands*, giving first a brief description of the species, then its habitat, and finally fuller details and its uses (if any).

The work being primarily intended for the use of forest officers, it may be asked why it includes all herbaceous plants. In the *Flora of Chota Nagpur* only herbaceous plants of known economic value were described. Experience has shown that this is not a satisfactory arrangement. A forest officer has numerous inquiries addressed to him as to the possibility of obtaining this or that plant in his district. If he does not find it in the provincial flora he may not know whether it occurs or not, and where a vernacular name only is given for his guidance in the indent, he may send something quite different to what is intended. Or it may happen that the economic value of the plant is a new discovery, and therefore, although it may occur in considerable abundance, it will not have been described. I need only quote recent demands for *Chenopodium ambrosoides* (which occurs), for Belladonna and for Henbane (neither of which occur), for *Dhatura* (of which some species occur), and for *Gymnema sylvestris* (which occurs). If the plant be one of a genus of which two or more species occur, it is very essential that *each* be fully described, or the wrong species may be collected. This consideration brings one to the relative uses of a book arranged on the key system only, and one with more complete descriptions. The first, when written by a professional botanist, is very useful to botanists, and also more handy, but for the majority of people who take an interest in plants, whose technical knowledge is more restricted, fuller descriptions of species are essential to prevent errors in identification. Such errors are exceedingly likely to occur when the plant whose identity it is sought to establish has not before been recorded from the province, and is therefore not in the key—a circumstance likely to be of frequent occurrence in the present state of our knowledge of Indian provincial floras. The above are merely utilitarian reasons for endeavouring to include as many of the indigenous plants as possible in the Flora, but I venture to think that those who study plants merely for the love of them and what they teach are as worthy of consideration as the practical man. For these an insignificant, otherwise useless plant is as much worthy to be known and named as economically the most important. Finally, it frequently happens that a botanist or forester wishes to identify a plant which is not in flower, or otherwise in a condition showing the particular characters for which the key is adapted. In these cases as many characters as possible are necessary for his purpose, both in descriptions of the larger groups and the species.

The work in the Calcutta Herbarium, carried on in a bad state of health, would not have been possible had it not been for the very

great kindness of Col. Gage, the then Director of the Botanical Survey, who not only gave me assistance in the Herbarium itself, but placed his own residence in the gardens at my disposal, thus obviating a tiresome daily journey to and from the Herbarium and Calcutta. My thanks are also due to Mr. C. C. Calder, the Keeper of the Herbarium during the same period. During the four years employed in writing the Flora, since my return to England, I have repeatedly had to consult the great Herbarium and Library at Kew, and acknowledge with much gratitude the facilities for study given to me by Sir D. Prain and Dr. Hill, successively Directors of the Royal Gardens, and by Dr. Stapf and Mr. Cotton, successive Keepers of the Herbarium and Library. I am indebted to Sir D. Prain also in another way. His book on *Bengal Plants* covers, in addition to the present province of Bengal, the greater part of the ground traversed by the present work, and has served especially as a most useful guide for the existence of specimens in the Sibpur Herbarium, thus decreasing my own labours in searching for records, and indicating the existence of many which might otherwise have escaped my necessarily hurried inspection. To Messrs. Wright, Dunn, Hutchinson and Turrill, of the Kew staff, thanks are due for ever-ready help, and particularly to Mr. Skan for assistance in matters pertaining to the Library. To Mr. Gamble I am indebted, as usual, for the loan of specimens, and I have also had the advantage of the first two parts of his splendid *Flora of Madras.* Since completing part of this Flora, Mr. B. Chattarjee, of the Forest Department, has kindly sent a few specimens from Angul and the Santal Parganas. One or two of these are new records for the district, and, as in the case of other collectors, where known, his name appears in italics after the name of the district in the localities for the species concerned.

For the preparation of the Index to the Flora grateful thanks are tendered to my niece Miss Sylvia Haines and her sisters.

My final acknowledgments strike a chord of sadness. Both those forest officers who took the most interest in the production of this work, and sent specimens from the tributary states of Orissa have passed away. Mr. A. N. Grieve and Mr. G. M. Cooper, both young and energetic officers, fell victims to fever and overwork in the course of their professional duties. My old friend Dr. Campbell, to whom I am indebted for so much help and sympathy, also died shortly before I left India.

H. H. HAINES.

Wimborne,
Dorset;
20 *Feb.*, 1925.

CONTENTS.

PART I.

	Page.	Para.
MAP (General) *in pocket*.		
PREFACE	v	
TABLE OF CONTENTS	x	
INTRODUCTION :—		
Chap I.—Area and Boundaries . . .	1	1
Chap. II.—Topography and Geology . .	1	2–77
Chap. III.—Climate (with Rainfall map). .	19	78–95
Chap. IV.—General Character of the Flora and Œcology	28	96–177
Chap. V.—Special Notes on Hazaribagh and Monghyr (from other authors) . .	70	178–191
Chap. VI.—Classification :—		
General Principles and Data . . .	76	192–201
Pteridophyta	79	202–207
Spermophyta	80	208–221
Conspectus of Orders and Families . .	85	222
Pteridophyta	85	223–228
Gymnosperms	89	229
Angiosperms :—		
Dicotyledons	91	230–239
Monocotyledons	145	240–241
ABBREVIATIONS AND SIGNS	156	
GLOSSARY OF BOTANICAL TERMS USED . .	159	
TABLE OF CORRESPONDING ENGLISH AND METRIC LENGTHS	184	
ADDENDA AND CORRIGENDA	185	
INDEX TO PART I	189	

PARTS II–VI.—THE FLORA.

	Pages.
DICOTYLEDONS :—	
Thalamifloræ (with Euphorbiaceæ, Callitrichaceæ, Aizoaceæ and Samydaceæ)	3–149
Discifloræ	150–224
Calycifloræ	225–418
Gamopetalæ	419–754
Monochlamydeæ	755–842
MONOCOTYLEDONS	843–1182
VASCULAR CRYPTOGAMS	1183–1226
GYMNOSPERMS	1227–1232
APPENDICES—	
I. List of Plants collected by Buchanan-Hamilton in Bihar now in the Wallichian Herbarium at Kew	1233–1252
II. Additamenta: Description of Species Omitted (see also Addenda in Part I).	1253–1259
INDEX TO PARTS II–VI	1260–1350

INTRODUCTION.

CHAPTER I.

AREA AND BOUNDARIES.

1. The boundaries of the province of Bihar and Orissa are only to a small extent natural, *e. g.* the crests of the Sameshwar Hills on the Nepal frontier in latitude 27° 30′ bounding the area on the extreme north-west, the Ganges and its tributaries the Gogra and Karamnasa for a short distance on the west, and the waters of the Bay of Bengal on the south-east. The remaining boundaries (shown on the attached map), with the exception of other short lengths of river (the longest perhaps being the Kanhar on the west of Palamau), and the crests of hill ranges for short distances, are artificial. The extreme south latitude is 19° 2′ N. The total area is 111,829 sq. miles, or over one and a quarter times that of Great Britain.

CHAPTER II.

TOPOGRAPHY AND GEOLOGY.*

General, 2–8; Division of the area, 9–11; **Northern tract** 12–20; Sameshwar Hills, 13; The Gangetic Plain, 14–18; Hills in the south of the Northern Tract, 19. **Central tract** 21–56; Kaimur Hills, 21; Gaya and Monghyr (Gidaur Hills), 23, 24; Rajmahal Hills, 25–34; Note on the *Glossopteris* Flora, 28, 29; The main Central tract, 35–56; Parasnath and the Tundi Hills, 39; Boundary of the Central tract on the south, 41; Geology of the main Central tract, 42–56; Gneiss, 42; Dharwars, 43; Granites and Dome gneiss, 45; Mica, 36; Vindhyans, 47; Kadapahs, 48; Gondwanas in the main Central tract, 49–53; Igneous dykes, 52; Laterite, Kankar and Regur, 54–56. **Southern tract**: General, 57; Archæan rocks, 59; Doubtful archæan, 60; Dharwars, 61; Growth on clay schists and iron schists, 62; Magnesian schists, 64; Trap dykes, 65; Kadapahs, 66; Growth on the Kadapah sandstones and shales, 68; Gondwanas of the Southern tract and Table of Gondwana strata (footnote), 69; Coal-bearing sandstones of Gondwanas, 72; Laterite, etc., 74; Table of the principal geological formations, 77.

* For the geology I have made much use of Vredenburg's *Summary of the Geology of India* (1910), and also the various memoirs of the Geological Survey, especially papers by Ball. I have also consulted Martin Duncan's *Abstract of the Geology of India*, prepared for the use of students at Cooper's Hill College, and also the geological chapters in the *Gazetteers* of the province. A detailed text-book on the Geology of India is still a desideratum, but I understand this is under preparation by E. W. Vredenburg. At the time of Medlicott and Blandford's *Abstract of the Geology of India* very little of our province had been geologically examined, and considerable areas still remain to be examined.

GENERAL.

2. Very few of the older administrators or writers on India appear to have appreciated, or even realized, the great natural beauties and the absorbing interest of the manifold natural objects with which the country once abounded, and which, alas, partly through their apathy, it has now mostly lost. What the Creator gave in these respects might have been to a great extent saved, and even have been accompanied by material as well as spiritual profit.* Now that they are gone they are to a great extent irretrievable. So far as the records show, the dominating ideas were the spread of agriculture, increase of population and the development of the country from a revenue point of view. Not only was the æsthetic view wanting, but even Europeans sometimes appeared to regard with a horror, quite inconceivable to the present writer, what is unfeelingly referred to as dismal waste or jungle, which is but one way of expressing the glorious harmony of forest-covered hills with their wealth of natural animal and plant life—a harmony impossible where man's works are concerned. Even the utilitarian aspects of the forests were discovered too late to save a sufficiency of them for those direct and indirect benefits which they confer.

3. The greater part of the Gangetic Plain had long before the advent of Europeans lost almost all pretence to natural beauty, but much of the Central and Southern tracts still retained some portion of wild nature, though but a vestige of their primeval loveliness.

Walter Hamilton, who (1820) included Sambalpur, Angul, and many of what are now the feudatory States of Orissa in his "Gondwana Province," described the latter as "consisting of wild and wooded countries affording little or no revenue or supplies . . . rugged and mountainous and overrun with thick jungle, no army of any considerable number or equipment could penetrate them."

4. Singbhum, Mahurbhanj, Keonjhur, Balasore, Cuttack and Khurda (Puri) were included in his "Orissa Province." Of these districts also he remarks: "The interior of this province remains in a very savage state, being composed of rugged hills, uninhabited jungles, and deep water-courses, surrounded by pathless deserts, forests, or valleys, and pervaded by a pestilential atmosphere . . . the high lands are infested with wild beasts . . . the rivers and waters swarm with fish, reptiles and alligators (*sic*); the plains and jungles with winged vermin."

5. Even Buchanan-Hamilton, a botanist and zoologist, is so obsessed with the usual official view as to complain of any part of a district lapsing to a state of nature—an attitude no doubt corresponding with that of the majority of hard-headed Britons, though the Wordsworthian view would appear more appropriate to a naturalist. He does, however, raise a strong protest against the reckless waste of natural resources going on in his time. In his account of the southern part of Bhagalpur (the Monghyr district, etc.), he says: "The causes assigned for the stunted condition of the forests are: (1) Burning.

* Some of the Indian poets seem to have fully perceived this.

Every year in spring the whole forests are burned. (2) Resin tapping. (3) Extraction of Catechu, even roots being dug up. (4) Rearing of Tasar. (5) Cultivation (jhuming) by the hill tribes. (6) Cutting of timber. (7) Want of economy in cutting fuel. The havoc that is now wrought by every one using the first tree that suits his purpose is vastly greater than I could have imagined. I shall take the liberty, on account of the magnitude of the evil, of earnestly again recommending the subject to the consideration of government."

6. In the *Statistical Reporter* for January, 1876, an article appeared on the "Natural Productions of the Karrukpur Hills." It is stated that "the utter absence of all forest conservancy has long ago caused the disappearance of all the giants of the forest, and even when the East Indian Railway was commenced, the contractors for sleepers found a lease of these hills on moderate terms a losing speculation." Sal trees fit for sleepers were even then few and far between. The same writer (from internal evidence; no name is appended), in this periodical for March, 1877, in an article entitled "The Forest Flora of Monghyr," again refers to the reckless waste of natural resources in that district. He says: "The most casual observer will at once detect the ravages made by the agency of man. Not only is the woodman's axe never at rest, and the underwood consumed as firewood, but cows, sheep and goats, in locust-like swarms, are let loose in the woods, until the wonder is that any green thing survives. Indeed, near the towns of Monghyr, Jamalpur and Sheikpura, a clean sweep has been already effected . . . only a few stinging-nettles and crotons have been competent to hold their own against the fierce hunger of the animals. Notwithstanding, however, the denudation which goes on, Monghyr is still a well-wooded district."

7. As is too often the result in these cases, no heed was taken of the warnings, and no steps were taken towards the forest conservancy of the Monghyr Hills. Had they been placed under forest management at that time, they would now have been a useful asset to the country.

8. Similar reduction of once useful forest to useless scrub in recent times has taken place in the Shahabad Hills (p. 6), Hazaribagh, and the Rajmahal Hills (see pp. 6, 8, 70), and the province now only contains between 2 and 3 per cent. of its area under forest properly reserved.

9. *Division of Area.*—The area is conveniently divided up into three main topographical divisions, a central highland, which forms a main water-parting, a northern mostly (Gangetic) plain area, and a southern area containing numerous mountains and several rivers which flow direct from the province into the Bay of Bengal. These are frequently referred to in the Flora as the Central, Northern and Southern tracts respectively.

10. It will be observed that some districts fall partly into the Northern tract and partly into the Central tract. Thus Shahabad, Monghyr and Bhagalpur have also all considerable hill tracts on the south which fall naturally into the Central tract. Gaya has also a few hills adjoining the Central tract.

11. The detailed topography of the districts would take up too

much space to be dealt with in a Flora. Very complete accounts are given in the recent excellent *Gazetteers* published by the Government of the province.

NORTHERN TRACT.

12. On the extreme west of the northern frontier is a small section, the Sameshwar Hills already alluded to, of the foothills of the Himalaya, but these forest-clad mountains, with their wealth of vegetation, are for the most part beyond the Nepal boundary, and the bulk of our Northern tract is occupied by the large alluvial plain of the Ganges, densely populated and closely cultivated. On the northern side of the Ganges the plain varies from 70–90 miles in width, north to south. On the southern side it is about 100 miles wide on the west, but becomes rapidly constricted eastwards by the central highlands, which finally meet the Ganges itself where that river sweeps round the base of the Kharagpur and Rajmahal Hills.

13. *Sameshwar Hills.*—The Sameshwar Hills in the north of Champaran are very distinct geologically and floristically from any other part of the province. They are composed of sandstones and gravels of the Siwalik system. The soil is mostly sandy, but some rather red argillaceous soils occur towards the Bhabsa river, probably derived from shales of the same system.

14. *The Gangetic depression* probably represents the bed of an ancient sea, and it is filled up with alluvial deposits of immense depth. This alluvial ocean is dotted here and there in the south with islets of archean rocks, or with small hill ranges which may be considered rather as part of the Central tract. The soil varies from clay to sand, and patches of "usar"* are frequent in Darbhanga and Muzaffarpur and to a less extent in other districts. Reh is connected with want of sub-soil drainage and excessive evaporation. Where the salt is not excessive, *Acacia arabica*, *Sissu* and *Butea frondosa*, besides several grasses such as *Chrysopogon aciculatus*, *Diplachne* and *Sporobolus*, will grow on such land. That there is no very characteristic halophytic flora in these usar lands of Bihar is probably due to the washing away of the "reh" or salt efflorescence in rainy weather, and a covering of vegetation tends to prevent its accumulation.

15. Geologists distinguish in the Gangetic plain between the older and the newer alluvium. The older is usually composed of argillaceous beds of a rather pale reddish-brown hue. In it kanker and pisolitic ferruginous concretions are disseminated. *Kanker*, an impure carbonate of lime, like *reh*, seems often associated with defective drainage and a hot sun, and it is by no means confined to alluvial formations (*cp.* p. 18).

16. The great rivers of the Gandak and Kosi, and innumerable

* Usar is land impregnated with saline matter, and the efflorescence of the salts is termed "reh." These salts vary in composition, but consist usually of carbonate of soda with sulphate of soda, and to a less extent of lime and magnesian salts and sodium chloride. See Ball, *Economic Geology*, iii, p. 696; Watt, *Dictionary of Economic Products and Articles in the Indian Forester*.

smaller ones, divide up the alluvial plain to the north of the Ganges into areas of varying fertility and slightly different levels. Where the later floods do not deposit silt the "diaras" or "churs" in the river beds are raised, sandy and barren or covered with coarse grasses. The rivers are sometimes connected by channels called "chars" of considerable depth and width, in which the water will flow in one direction or the other. At other times stretches of old river-bed, now altogether cut off from the present rivers, form long marshes or even lakes, with a rich vegetation of aquatic plants. The marshy depressions in Champaran are sometimes called "chaurs."

17. That part of Shahabad in the Northern tract has no marshes or lakes which so often characterize other districts, except an old bed of the Ganges (near Bhojpur). Buchanan-Hamilton says that the whole of the inundated land near the Ganges is covered with reed and Tamarisk, but that he saw none of the wild rose so common towards the east.

18. The great uniformity of level of the Ganges plain is evident from the elevation at the junction of the Gandak being only 168 ft. above the level of the sea, a distance of some 450 miles! The vegetation, however, gradually changes from west to east in consequence of the increase in the rainfall, as will be seen by the table on p. 21, and Purneah has a more or less permanent greensward, whereas Saran is one of the driest districts in the province.

19. *Hills in the south of the Northern area.*—The districts bordering the Ganges on its southern bank are more diversified. Except Patna, they all pass into the central highlands on the south. Even Patna has part of a range of hills, the Rajgir Hills, on its southern boundary, but these enter it from Gaya, and only form a part of the south-east boundary of the Patna district. They reach 1472 ft. elevation at Handia Hill, and consist of schists and slates with massive beds of quartzite. In the Gaya district they end rather abruptly south of Gaya town. Their whole length of about 40 miles, including two breaks, is entirely isolated from the Central highlands by the alluvium, but they are geologically similar. They bear a scrub jungle with scattered Sal trees like the nearest southern hills. A few other unimportant isolated hills occur in the Gaya alluvium.

20. The southern parts of Bhagalpur present a considerable area of granitoid and porphyritic gneisses towards Monghyr and the Santal Parganas, sometimes showing as dome gneiss as at Mandar hill, and varying to foliated gneisses and schists as in the Central tract. Damuda rocks occur at Pathargatta Hill, and east of Pathargatta the Damuda sandstone is overlaid by dark green basaltic trap, as in the neighbouring Santal Parganas. In the southern division also a broad and well-raised belt of limestone extends along the bank of the Ganges about 60 miles from near Monghyr to Colgong. It is about 2 miles broad and the town of Bhagalpur is situated on it. Its botany does not appear to have been specially investigated, but it is said to be densely covered with mango, jack and palm trees.*

* Account from *Gazetteer*. Mandar Hill is on the railway south of Pipra Station.

CENTRAL TRACT.

21. *Kaimur Hills.*—The north of the Shahabad district is a low-lying alluvial plain and one of the principal wheat-growing tracts belonging to the Northern tract; the southern 800 square miles is an undulating mass of low hills, or rather a plateau, known as the Kaimur Hills. They are one of the ragged terminations of the great Vindhyan range, separated from the main mass in our province by the river Sone, on which they abut with cliff-like escarpments. These Kaimur Hills extend westwards into Rewa outside our area, and there become fused with the main range. They belong therefore to the Central tract, and consist of sandstones, shales and limestones, are unfossiliferous, and are assigned to the Vindhyan formation which is usually placed near the top of the Azoic formations (see p. 18).

22. The sandstones are the most important rocks as usually concealing the other rocks, and give the somewhat flat-topped character to the country with almost vertical escarpments, and are responsible, apparently, for the *Hardwickia binata,* once prevalent here, though now almost destroyed. The Kaimur Hills must at one time have borne magnificent forest, and Sir J. D. Hooker records specimens of *Hardwickia* 120 ft. high as existing even in his time. Unfortunately they were never placed under forest conservancy, and are now mostly covered with a scrub jungle, with scattered Sal in some places. They are not well known botanically, although visited by Hamilton. I have only examined their eastern extremity.

23. *Gaya Hills and Monghyr Hills.*—The hills on the southern border of the Gaya district are merely the northern scarps and outliers of the Palamau and Hazaribagh plateaux. In Monghyr, and again in the Santal Parganas, they form well-marked ranges.

24. The Gidaur Hills, which lie across the southern boundary of Gaya and Monghyr, are composed of Dharwars,* including micaceous and ferruginous schists so highly metamorphosed by intrusive coarse pegmatitic granites that they yield workable mica. The rocks of the Kharagpur Hills are not nearly so much altered, the shales being converted to slates rather than into schists. The two ranges are more or less connected on the south by Archæan gneiss of lower elevation. A description of the flora of these hills was given by Buchanan-Hamilton. They are still more or less covered with scrub jungle, but at one time bore good Sal forest.

25. *Rajmahal Hills : Gondwana Rocks.*—The Rajmahal Hills are also conveniently treated separately from the main Central area. They form a long broad backbone in the Santal Parganas district, running south and north, and almost abutting on to the Ganges,

* The Dharwars were formerly known as the sub-metamorphic or transition series. They underlie the Lower Vindhyan formation, and overlie the fundamental or Bengal or archæan gneiss, once called metamorphic, now believed to represent the primitive crystalline rocks resulting from the original cooling molten mass of the earth's crust. The Dharwars are metamorphosed sedimentary rocks, often so highly altered as to pass into the archæan in appearance. They include slates, quartzites, quartz, hæmatite and mica schists, phyllites, etc.

which takes a sudden bend to the southwards after passing their northern foot.

26. The Rajmahal Hills proper are connected with the Central highlands by a lower tract, but still high ground, of more undulating country with isolated hills and ridges. They differ geologically from most of the Central tract in belonging to the Gondwana system,* and in being interbedded with trap.

27. Vredenburg says that "in the Rajmahal Hills the Upper Gondwanas exhibit the exceptional facies of a volcanic series, consisting of some 2000 ft. of basaltic flows, with occasional intercalations of clays, carbonaceous shales and siliceous porcellanoid shales, which have long attracted attention on account of the abundance of beautifully preserved fossil plants which they contain, remarkable for the abundance of ferns, principally *Tæniopteris* and *Dicksonites*, and *Cycads*, principally *Ptilophyllum*." It is now known, however, that many if not most of these fern-like plants were seed-plants, and belonged to the interesting group of Pteridosperms.†

28. The Pteridosperms, fern-like plants which, however, bore seeds, were one of the constituents of the great "*Glossopteris* Flora," which was characteristic of the hypothetical continent "Gondwanaland." Possibly that great continent now hides beneath the sea the origin of the Pteridosperms and of the Angiosperms. In Permo-carboniferous times the plant remains indicate two great botanical provinces, a northern and southern, and it is the similarity of many of these remains of the Southern flora in South America, South Africa, Southern India (including especially the Lower Gondwana rocks) and Australia, to which the name "*Glossopteris* Flora" has been given, that forms the strongest evidence for a previous land connection between these regions.

29. "*Glossopteris*" itself is probably only a form genus. The name was first given to sublanceolate or oval leaves with a strong midrib, and very close sub-parallel anastomosing secondary nervation. The leaves are of two kinds. The larger appear tufted on the rhizome or stem, and the close secondary nerves are scarcely distinct from the tertiaries, which with them form a close oblique reticulation with ellipsoid areoles (in *Gl. indica*; the areoles are broad in some species). The second kind of leaf are scale leaves. They have no midrib and were also apparently attached to the rhizome, otherwise they might be comparable to the small simple pinnules springing from the rhachis between the pinnæ in some species of *Neuropteris* which were also reniform or orbicular in shape and without a midrib. The rhizomes or stems of *Glossopteris* were originally known as "Vertebraria" from their apparent articulation, and are about 1″ diam. Unfortunately all the specimens are mere casts and are not therefore in a state for anatomical investigation, and the only sporangia found might be the micro-sporangia of *Cycads*. The *Glossopteris* type is commonest in the Lower Gondwana. From the Talchir-Kaharbari beds (see p. 16, footnote) in or near our area‡ have been recorded *Glossopteris* (*Vertebraria*) *indica* and other species, *Neuropteris*, *Gangamopteris*, etc.; from the Damudas many species of *Glossopteris*, and there is a specimen of *Glossopteris indica* (in the British Museum) collected from Buckley Island near

* The Indian Gondwanas is the main coal-bearing formation of India. The Lower Gondwana correspond roughly with the Permian, the Middle and Upper with the Trias and Jurassic respectively. See also Tabular Statement of the Gondwanas on p. 16.

† See Scott, *Studies in Fossil Botany*, third edition, pp. 1–242, etc.

‡ It should be observed that specimens said to be from Rajmahal may be from the Raniganj coalfield, situated alongside our area, but in Burdwan. This confusion appears to have originated by Brongniart in 1828, who obtained the first Indian specimens of *Glossopteris* from "Ranagunge, near Rajemahl." There are a few unimportant coalfields along the western border of the Rajmahal Hills, but none are, I believe, now worked, while the Burdwan coalfield at Raniganj is one of the most important. There are also coalfields in Manbhum (Jharia) and Hazaribagh (Giridih), all in the Gondwanas.

the South Pole by members of the British Antarctic Expedition (1910–1913) by Dr. Wilson and Lieut. Bowers only a few weeks before their deaths. In the Damudas also occur *Sphenopteris* and *Alethopteris* (probably all Pteridosperms) and *Tæniopteris*. A fern of the modern genus *Actiniopteris* (*A. benghalensis*) was at one time supposed to have been identified, but probably quite wrongly, and it is perhaps even not a fern. *Sphenopteris* is a form genus with 2–3-pinnate fronds superficially resembling some *Davallia* or *Asplenium*, but some species at least have the fronds forked. From the Panchet rocks are recorded *Glossopteris*, *Tæniopteris*, *Pecopteris concinna* (*Pecopteris* is a form genus probably comprising some ferns and some Pteridosperms), and *Cyclopteris*, possibly a fern. In the Upper Gondwana the *Glossopteris* type is rare, and at this epoch there appears to have been an admixture of the northern and southern floras, but the Rajmahal flora contains a very large number of *Cycadophyta*, including *Tæniopteris* (probably one of the *Williamsonieæ*) and a *Sphenopteris* (*S. arguta*), said by Duncan to be common to the Rajmahal and the Lower Oolite of Yorkshire !*

30. Although most of the Rajmahal Hills are included in the large Government estate of the Damin-i-koh the forests are not reserved, and these hills show a terrible example of rapid denudation. When one reads that within comparatively recent times wild elephants and rhinoceros were found in the district, and that the East Indian Railway obtained sleepers for its line from the Rajmahal Hills, the rapidity of the forest destruction is almost incredible. This destruction cannot but have had, and is no doubt still having, a pernicious effect alike on the climate, the cultivation of surrounding tracts, and the water supply. Floods and droughts alternate, as is usual in denuded districts.

31. The hills have mostly flat tops, as is common in trap districts, and most of these tops are under indifferent or shifting cultivation† by the Mal and Sauria Paharias. Some of the slopes are, however, cultivated with sabai grass. Common trees on the trap are *Mohwa*, *Nyctanthes*, *Eriolæna*, *Asan*, *Wendlandia exserta* and *Heteropanax* (on shady sides), but none are peculiar to it.

32. The nature of the surface, which in many cases is covered with rounded trap boulders, fortunately makes such parts of the forest more or less self-protecting against the pernicious effects of heavy grazing. The volcanics rest unconformably upon the Dubrajpur sandstone (of the middle Gondwanas), and where these are exposed the cattle find a good footing and the surface quickly becomes barren. Some of the outer hill blocks in the north are mostly sandstone or grit. Thus Belpahar shows the white rock exposed on the slopes from the excessive tread, and the surface is not only treeless, but now becoming bare of grass. On the top is shale which wears better, and here *Nyctanthes* and Sal saplings still struggle for life. Some spurs in the northern Godda Hills appear to be of trachyte, and this rock is well covered, though only with thorny scrub, and there is much *Breynia rhamnoides*. The Mahanadi block is also covered with boulders of granite with *Diospyros tomentosa* and *Hollarhena* as the surviving trees.

33. The highest hill of the Rajmahals is perhaps Mori, which is about 2000 ft. high; it is capped by laterite. Dumka, the head-quarters station, lies off the main ridge, and is only 500 ft., and this

* For a full and very interesting account of the *Glossopteris* Flora see the *Catalogue* by E. A. Newell Arber published by the British Museum (1905).

† Here called "Karao."

part of the Santal Parganas, as on the west, has an undulating surface, and is chiefly under cultivation.

34. Cotton soil, a product of trap, occurs in some areas, while some of the rivers which rise in the hills, such as the Bansloi, cut their channels deep enough to expose the underlying gneiss.

Main Central Tract.

35. The Central tract *proper* is a region of plateaux and mountainous spurs which are the eastward termination of the huge Satpura-Vindhyan massiv which radiates from Amarkantak (see map), in the Central Provinces, elev. 3493 ft. above sea-level. Near this point rise the Narbada running to the west, the Sone running north to the Ganges and the Mahanadi to the south and east, the last two rivers being for a considerable distance within our province. This elevated central tract has a trend somewhat north of east, and is mostly over 1000 ft. in elevation. It ends in the Rajmahal Hills (see above).

36. Formerly a densely forest-clad country, it is now more or less denuded of forest except on the broken flanks of the plateaux and more rugged hilly outliers, and is becoming worse every year. This denudation is no doubt correlated with the disastrous floods that take place periodically, both in the Gaya district to the north, in parts of the Santal Parganas, and along the course of the Damudar in Bengal.

37. The two main plateaux, those of Ranchi and Hazaribagh, are each about 2000 ft. high, separated by the deep valley of the Damuda, and carry, especially on the west, still higher plateaux (usually 1000 ft. higher), which are known as "*páts*." On one of these pats, on the borders of Ranchi and Palamau, is situated Neterhat, developed (by Sir E. Gait) as a readily accessible sanatorium.

38. Towards the edges of the plateaux are very frequently ranges of hills or mountains, which in some cases reach the elevation of the *pats*, and the scarps usually fall away in rugged spurs and hills which I have termed the "ghats," cut up by ravines and rivers, but rarely with the precipitous sides characteristic of the sandstones of the Kaimur Hills, and never with the noble scarps characteristic of the sandstones of the Pachmari Hills in the Central Provinces.* At the same time the rugged ghats form a very beautiful feature of the province, and are some of the best botanical ground in the area. With the exception of the few reserved forest areas, the tops of the plateaux are for the most part under cultivation, occasionally varied by stony hills with scrub jungle, whereas the ghats and outlying ranges, like the Tundi Hills, are forest- or jungle-clad.

39. *Tundi Hills and Parasnath.*—Some of the outlying spurs form regular hill ranges such as those already dealt with as projecting into the Gangetic Plain, which really belong to the Central tract. One of these outlying ranges, the Tundi Hills, extending across the boundary of Manbhum and Hazaribagh, and to the east of Hazaribagh itself, contains the highest mountain in the province, Parasnath. The

* These sandstones belong to the Kamthi group of the Gondwanas.

Tundi Hills form a water-parting between the Damuda and Barakar rivers. Parasnath is well known from its being described by Hooker in the Himalayan journals. It has also been botanized by Anderson, Thomson, Clarke and others. Its elevation is 4430 ft.

40. To the east of the central highlands and between it and the Bengal boundary is an irregular, not very wide, area of lower-lying ground, chiefly in Manbhum. This merges gradually into the lower Gangetic plain of Bengal, and is cultivated country.

41. The Central tract may be considered to be roughly bounded on the south by the Bengal-Nagpur Railway, which passes up the valley of the Sanjai to the water-parting of that river and the Brahmini river, and then passes into the valley of the Mahanadi. The ridge of high ground between the Sanjai and the Brahmini is pierced by a tunnel, and the line here practically separates the Porahat forest division from the Singbhum forest division.

42. GEOLOGY OF MAIN CENTRAL TRACT.—*Gneiss.*—The basis of the Central tract geologically is the Archæan or Bengal gneiss, gneiss being considered now to be one of the primordial rocks of the globe, and the formation, as it were, of all other formations. The greater part of the Manbhum, southern Santal Parganas, Ranchi, Palamau and Hazaribagh districts show either exposures of the rock itself, or the immediate products of its decomposition, and, as already said, it dips under the alluvium of the Northern tract. It usually gives rise to a reddish stiff loamy soil, excellently suited to the growth of forest while kept covered, but bakes to a brick-like hardness in the hot season when denuded. This soil is sometimes of immense depth on the plateaux. The Bengal gneiss rarely stands out as prominent hill ranges. Parasnath, which is apparently of gneiss, is believed to belong to what is known as Nilgiri gneiss, a form distinguished petrologically by the constant presence of enstatite (ferrous magnesium silicate).*

43. *The Dharwars.*†—Most of the higher hills resting on the foundations of Bengal gneiss, and the rocks forming the ghats, belong to the sub-metamorphic crystalline series or "Dharwars," sometimes so highly metamorphosed as not to be distinguishable lithologically from the Archæan rocks. A direct connection can, however, often be traced between outcrops of highly metamorphosed Dharwars with others undoubtedly of sedimentary origin, leaving no doubt of their relationship. Vredenburg especially instances the belt of which the northern edge (a fault) extends along the south of part of Ranchi and Manbhum districts. The southern part of this belt consists of slates, sandstones and limestones, while along the northern margin these rocks become crystalline.

44. Most of the forest-covered Palamau hills are of *Dharwars,* and much of the Porahat forests. They (the Dharwars) have already been mentioned as forming part of the Gaya and Monghyr Hills. In the Gidaur range they contain ferruginous schists and much slate of good quality which is quarried. The Rajgir Hills are mainly quartzite

* Vredenburg, *Summary of the Geology of India,* p. 13.

† See also p. 14 under the Southern tract.

and slate, and very barren, not because forest will not grow on quartzite, but from the lack of forest conservancy and unrestricted grazing.

45. *Granites and Dome-gneiss.*—Thrust up through both the Archæan and Dharwar rocks are frequently true granites, which in many cases have resisted disintegration more slowly than the surrounding rocks, and assume the shape of conical or rounded hills, whence the term "dome gneiss" (more properly *dome granite*) has been given to the rock. The shelling off of the outer concentric layers of this rock renders it singularly bare of vegetation. On it species of *Ficus* are the commonest plants. The detritus at the base of these conical hills may, however, be well covered. Excellent examples of the "dome gneiss" may be seen on the Purulia-Ranchi road near Jhalda.*

46. *Mica.*—When these granites are in the form of a dyke they frequently become pegmatitic and where such dykes traverse mica-schists contain workable mica, as in the well-known mica-belt along the Hazaribagh-Gaya ghats which extends into the Gidaur Hills. On the south of the Ranchi plateau, north of Bandgaon and about Muru, pegmatite and large mica-plates have also been observed, and may perhaps become workable. The large hill known as Koderma Hill in the Dharwar mica-belt appears to be granitic, perhaps dome-gneiss. It contains no workable mica. Mica (composed of silica, alumina, magnesia, iron oxides, potash) is singularly proof gainst decomposition, so that old waste mica-dumps of over 30 years' standing remain barren of all vegetation.

47. *Vindhyan series.*—The Naga Untari Hills, situated in Zemindaris in the extreme west of Palamau, and covered with poor forest from which all large timber has been removed, are noteworthy from their abundant crystalline limestone, especially near Bonahatpur. It is frequently hollowed out into caves which form a refuge for bears. In these hills is also Biotite gneiss and a brownish slaty-looking rock with a black dull fracture (lydianstone ?). These formations are possibly Vindhyan, like those on the opposite side of the Sone. Vredenberg speaks of the Vindhyan rocks spreading beneath the Sone, but generally overlaid by alluvium, and of volcanic rocks of the porcellanic group of the same formation occurring in a belt in the west of Gaya and Palamau about Nabinagar and Japla.

48. *Slate of Kadapahs.*—Near the Mirzapur boundary in Palamau is found the easternmost outcrops of a large mass of slate which belongs to the Kadapah System (or Algonkian, post-Dharwar and pre-Vindhyan), the only known rocks of this system, I believe, in the Central tract.

49. *Gondwana rocks.*—After the Cambrian (Vindhyan) period the Central and Southern areas remained a land area and no longer received any marine deposits, but fluviatile and lacustrine (besides volcanic deposits) are of considerable importance. The Gondwana system of the Rajmahal Hills has already been referred to (para. 26 *et seq.*).

* For an excellent illustration see vol. xviii of the *Memoirs of the Geological Survey of India.*

50. Lower Gondwana sandstones occur in depressions in the main Central tract, especially along the Damuda Valley, between the Ranchi and Hazaribagh plateaux. Clays and carboniferous shales of this Damuda series may be seen where the Ranchi-Hazaribagh road crosses the valley (near 21st mile). The Gondwana system is well developed again in the parallel Barakar valley, the Giridih coal-field of Hazaribagh, and tilted beds of sandstone north of Bagoda as well as micaceous shales composing the small hills north of the Barakar possibly belong to it. The grits and sandstones to the south of Giridih are thrown into scarps and ridges formerly covered with Sal forest.

51. In Manbhum the now dreary waste of country known as the Jharia coalfield is mainly Damuda sandstone, but outcrops of conglomerate and black shales and also the underlying Talchir boulder beds occur.* This area is remarkable in the rainy season for the vast quantities of the American weed *Hyptis suaveolens*.

52. Igneous dykes are of common occurrence in the Jharia coal-field, and are said to belong to the same epoch as the much vaster outpouring of volcanic rock which characterizes the Rajmahal Hills.

53. A considerable area of the central Palamau plateau, extending from eastwards of Loharsee† into Hazaribagh and westwards to Garhwa, is occupied by Gondwana rocks, chiefly sandstones which are frequently calcareous. In this area are situated the small Auranga, Hutar and Karanpara coalfields. Still further west in the neighbourhood of the Kanhar river the flat-topped hills are capped by massive sandstone and laterite, the former being also perhaps of Gondwana age.

54.‡ *Laterite, Kankar and Regur.*—Subsequent to the Gondwanas, and with the possible exception of some of the traps and intrusive granites, there appear to be no newer rocks in the Central area with the exception of such subaerial deposits as laterite and kankar.

55. Laterite occurs principally as a cap to the higher plateaux or *pats*, but is also found of fair thickness in some valleys. In most cases it appears (except in the Rajmahal Hills) to rest directly on gneiss or, as on the Neterhat plateau, a felspathic granite. It also occurs in considerable sheets overlying the Bengal gneiss in Eastern Manbhum. In such cases it may be the results of the complete decomposition of an original trap layer.

56. The soil in the valleys of the Rajmahal Hills especially, but also in parts of Hazaribagh (*e. g.* between Chatra and Itkuri), Palamau (*e. g.* from Lesliegani to Banki), Singbhum (*e. g.* near Chaibassa), and in many places in other districts is a *Black-cotton* soil or "regur," the origin of which is also sometimes ascribed to trap rocks. The species of the Cotton soil in this tract are largely *Butea*, *Carissa*, *Zizyphus* and *Acacia arabica*.

* For a detailed account of the Manbhum coalfields, see Vredenberg, Appendix to the *Gazetteer of Manbhum*.

† I see that I have not placed Loharsee on the map. It is situated almost in a line between Daltonganj and Simaria, not far west of the Palamau boundary. It is on the map attached to the *Forest Flora of Chota Nagpur.*

‡ See also paras. 74-76.

SOUTHERN TRACT.

57. The Southern tract is not sharply separated from the Central, but is on the whole characterized by the much more diversified topography, and its river system has a direct outlet on the Bay of Bengal. It contains a confused and broken mountain system, only a small part of which is in direct connection with the central tableland. From the sea this appears as a continuous range of hills, broken by the Mahanadi valley, and forming the northern end of the Eastern Ghats. The large rivers of the Burubulang, Baitarni, Brahmini and Mahanadi flow largely through country which is beautifully diversified with hills and mountains still more or less covered with forest. The Southern tract, into which the mountains of the Kolhan in Singbhum more naturally fall than into the Northern tract, is principally occupied by the Orissa Tributary States. Only a small fraction, therefore, of its beautiful forests are Government property for the permanent preservation of which there is any guarantee.*

58. The generally more rugged sculpturing of the southern tract† has assisted Nature in resisting to a greater degree than in the Northern and Central tracts the destructive influence of man. On the east, it is true, there is a belt of flat open country more or less parallel to the coast and running back for a considerable distance up the broad valley of the Mahanadi, but even this belt is not homogeneous. On the coast itself there are stretches of sand and sand-hills alternating with deltaic and tidal mud with mangrove swamps. Both these tracts have a flora distinct from the interior. Behind this coastal belt is an area of cultivated alluvial and lateritic formations up to 50 miles in width near Cuttack and Balasore, but narrowed on the north by the outlying hills of Nilgiri and Mayurbhanj and again on the south by isolated rocky hills and tracts of scrub on a laterite formation. On the extreme south the boundary hills between our province and Madras meet the Chilka Lake, a large area of shallow water, separated only by sand-hills from the sea, and more or less fresh or brackish according to season.‡

59. *Archæan Rocks.*—As indicated above, it is difficult, except for an expert geologist, and with much study in the field, to discriminate between the highly metamorphosed rocks and schistose forms of the Archæan gneiss. Generally speaking, this last is far less in evidence in the Southern tract than in the Central. From a forest and botanical point of view the matter is not of much importance, as the soils yielded and the floristic formations are identical.

60. As Dharwar rocks are said to be absent from the hilly region of Orissa between the Godavari and Mahanadi, the quartzites and gneisses of the hills in the Mals of Puri presumably belong to the Bengal or Nilghiri gneiss. On the Khandobolo mountain (3000 ft.)

* The Political Agent, Mr. Cobden Ramsay, has, however, done a great deal in the direction of persuading the Chiefs of the States to protect their forest property.

† For an excellent account of the rugged and picturesque scenery of the tributary states of Orissa, see Cobden Ramsay in the *Gazetteer* of the States.

‡ For an account of the fauna of an island in the Chilka Lake and a list of its plants, see *Memoirs of the Asiatic Society of Bengal*, vol. vii, No. 4.

quartz-mica schist and micaceous quartzites are common, and most of these rocks closely resemble those of the Dharwars. Other hills, such as those of the Manibandh forest, contain massive quartz rocks with some laterite, and this forest contains a curious mixture of Sal with fleshy *Euphorbias* and *Randia malabarica*, the last a shrub more especially characteristic of the sandstones. In the Arang block the road was cut along the steep hillside through a dark, excessively hard quartzite,* very unlike an archæan gneiss. The other large hill ranges of the feudatory states south of the Mahanadi have not been examined by me, but the low-lying country in Khandpara and Daspalla is either gneiss or granite with laterite. The high plateaux of Kalahandi and the Gandamardan range, on the borders of Borosambar and Patna (state), are said also to consist of gneiss with laterite caps. North of the Mahanadi there is much gneiss and granite which in going from Cuttack to Angul appears to begin in Dhenkenal, about 6 miles west from Bongarsingh, and except where interrupted by the formation subsequently referred to, is found right up to Sambalpur. All the hills of the Hathibari range consist of gneisses, including quartz schists and quartz rock, which appear to me to be of the Dharwar formation. On the granites the soil is sometimes cotton soil or kunker. Exposures of archæan gneiss are frequent towards the boundary of the Southern area in Singbhum, Saraikhela and Gangpur. The surface soil is frequently cotton soil.

61. *Dharwars of Southern tract.*—The Dharwars form magnificent hill ranges in Singbhum, Bonai, Keonjhur and Mayurbhanj, and to a less extent in Gangpur. Some of the quartz- and mica-schists of Chichamura forest, quartz-schists in the Jhargati-Gharpati forest, and almost certainly the shale and phyllite-looking rocks in the Jhargati forest (all in the Sambalpur forest range) and similar rocks in parts of the Hathibari range and in the Angul forests appear to me to belong to the Dharwars. They probably form most of the mountains of Angul. Typically they consist of shales and phyllites with quartz veins, siliceous clay slates, quartzites or hard sandstones, and especially mica- and hæmatite-schists. Hæmatite and other iron schists are very widespread. Whole hill ranges, *e. g.* the Lokudburu range in Porahat and the Ghatkori hills in Saranda (Singbhum), are more or less composed of them and yield a very valuable ore, now largely worked.

62. The clay-schists are usually interbedded with quartz laminæ. On weathering the latter break up into innumerable quartz stones which sometimes conceal the fact that the subsoil is argillaceous. The clays derived from these schists are usually very impermeable after the heavy rains of the monsoon, and are baked a stony hardness in the hot season. They support a hill-type Sal often characterized by the presence of *Gardenia*, and when once disforested are very barren and difficult to restore.

63. *Sal on the Iron Schists.*—The forest growth on the iron schists is better, the roots being better able to penetrate the numerous clefts and fissures which are characteristic of these rocks, and some of the

* Probably Khondalite.

finest Sal is found in the valleys on the detritus of hæmatite-schist hills, while on no other formation does the large Sal ascend so high on the hill-sides.

64. In Kundrugutu and some other places magnesian schists (patradiri, *K.*) are found which are worked by the Kols into ornaments.

65. *Trap dykes in the Dharwars.*—Trap dykes are very common, and at least one hill, the Kita-buru in the Saitba forest, is composed of serpentine. In this forest chromite is being worked. The Kitaburu is strongly magnetic and clothed mainly with grass and *Phœnix acaulis*. The highest hill of the Dalma range (in Porahat, close to boundary of Central and Southern areas) contains numerous trap intrusions, and is also capped with trap. Crystalline limestones of good quality are found in several places with the Dharwars, the best known deposit being at Bisra in Gangpur. In Gangpur also are considerable deposits of manganese, an ore very characteristic of this system in the Central Provinces.

66. *The Kadapahs of Southern tract.*—The Kadapahs is a formation closely resembling the Gondwanas and Vindhyans in many respects, but is older. It chiefly is composed of sandstones, but also very commonly limestones and shales. Extensive outcrops of limestone such as are met with in the neighbouring districts of Bilaspur and Raipur where the formation is better represented are not, I believe, met with in our area, though the *Gazetteer* speaks of limestone of this formation at Padampur.* The sandstones, as in so many other cases, are chiefly found forming cliffs and scarps. They may be observed in the town of Sambalpur (the circuit-house is built of them), where they are covered with *Oldenlandia Heynii* in the rains, and they extend west of that town to the boundary. They are also found south of the Mahanadi all over the Boropahar forest range, which extends south nearly to Pahar-sigida. This range consists of grits, sandstones and shales, but with granitic intrusions. The sandstones overlie the shales, as can be well seen in the exposures along the Bargat nala. They are very hard, almost quartzites, and the greater part of the hills consists of them.

67. Between Ambakhama and Santra the path first crosses these hard sandstones, which are almost bare of growth, and then passes over a ridge of massive shales which continue down the opposite slope to Mundkate and Santra villages. Between Lakhampur and Loharabehra there is a very striking escarpment of the same sandstones, poorly stocked as usual above, but with a narrow belt of good sal at its foot. At Lohara-behra blocks of hæmatite occur scattered on the surface (*cp.* below, sandstones at Tikapara in Angul). Here both shales and sandstones are exposed, but the most remarkable exposure of the shales is north of Ramadaga, not far from the Mahanadi. With grazing the more flat-bedded shales become singularly bare of all vegetation, and the surface shows curious dendritic markings.†

* Padampur is a town in Borosambar, but the Padampur referred to may be the zemindari of that name situated on our border, but just within the Central Provinces. I have not visited either place.

† I regret that I had no opportunity of getting specimens. They reminded one of fossil corallines.

68. All these Kadapah rocks grow somewhat poor forest, which is very poor indeed or the rock is quite bare where the lamination is parallel to the surface. The worst are the shales. Characteristic of the grits and hard sandstone are *Acacia Donaldi*,* *Bridelia Hamiltoniana*, and to a less extent, and usually near ravines, *Atalanta monophylla* and *Walsura piscidia*. Bamboo, *Cleistanthus collinus*. Satinwood, *Albizzia odoratissima* and *Bija* also occur. The most noticeable grass is the pest *Aristida setacea*. On the shales are found *Strychnos potatorum* and poor mixed forest. Sal only occurs on the alluvium near the rivers, and neither formation produces good Sal except when detrital.

69. *Gondwanas in the Southern tract.*†—South of Angul a range of hills in the north of Narsingpur show large outcrops of hard shale and sandstone. These appear to be continuous with sandstones about Tikapara on the Mahanadi (in Angul), and blocks of hæmatite were found at the base of the large Tikapara Hill, which has red (apparently sandstone) rocks on the cliffs near its summit (much hung with bees' nests). A pink sandstone was also found in the Tainsi forest in Angul. I would assign the above rocks of Narsingpur and Angul to the same formation as those in Sambalpur but that there appears no record of Kadapahs in this region, and they are possibly Gondwanas. In the sandstone between Purnakot and Tikapara there are trap dykes.

70. Gondwana rocks occur of considerable extent in the Southern tract, and there is here a new group known as the Athgarh sandstones, said to be near the top (*i. e.* in the Upper Gondwanas). These rocks, again, are principally sandstones (the Bhubaneswar, Konarak and Puri temples are built of them, and the Khandagiri caves cut out from them), but conglomerates and some shale-beds also occur. They occur all over the north of Puri district, and extend into Cuttack and Athgarh. The Rampur forest shows outcrops covered with thin laterite, the Chandka forest mostly grows on them with a little laterite on some of the scarps. The Hendesal forest has sandstone hills with a large laterite plain to the east, while the Barapita and Tirkai blocks are sandstone and conglomerate. There is much *Xylia* in some of these blocks, and introduced Teak is growing better on the sandstone (in Chandka) than on the laterite (in Khurda, further south).

* It was found on identical formations in the Central Provinces, *vide List of Trees, Shrubs, etc., of the Southern Circle, C.P.*, p. xv.

† The following table (from Duncan and Vredenberg) will make the succession of the Gondwana strata in our area clearer :

Upper	Rajmahal Hills.	
	Son-Narbada outcrops.	
	Athgarh sandstones, at head of Mahanadi delta.	
Middle or Mahadeva	Kamthi, outliers only in Damuda Valley. Dubrajpur sandstones.	
	Panchet beds at Raniganj (in Burdwan, just outside our area on Damuda).	
Lower	Damuda	Raniganj.
		Ironstone shales.
		Barakar.
	Kaharbari (Giridih coalfield).	
	Talchir.	

The Lower Gondwana are supposed to be on about the horizon of the Permian, the Mahadeva of the Trias and the Upper of the Jurassic.

71. Other Gondwana rocks, again chiefly sandstones which are often ferruginous, form hills in Rairahkol. These are said to be of the Mahadeva (Middle Gondwana group). The Kuhuri hill (Boita Mundiar) in Puri belongs to this group, and a section is well seen close to the town of Rampur (Rairakhol), where the river cuts through the strata, but here it is perhaps the Talchir boulder bed which is exposed, as it contains large boulders characteristic of that group. The Talchirs, as the name implies, is well represented in the small Talchir state, and the area known as the Talchir coalfield is said to extend about 70 miles from Rairakhol to Khadakprasad on the Brahmini River. The Talchirs, according to geologists, underlie the actual coal-bearing (Damuda) strata which do not appear so well represented. Besides sandstones they contain also fine-grained greenish-grey arenaceous shales. The flagstones of the P.W.D. bungalow at Nakchi in Athmailik appear to have come from these beds.

72. In the south of Gangpur are coal-bearing sandstones of the Damudas which are continued into the north of Sambalpur (*e. g.* at Rajpur). Both Talchirs and Damudas (Barakar beds) have been found at Rampur on the Ib not very far from some of the northern forests of the Sambalpur division, and the Talchirs are said to be prolonged south-east to the Brahmini River in Rairakhol.* If this were so, there would thus be a continuous series of Gondwana rocks from Gangpur to Puri and Angul (see below). But I am doubtful of such a connection unless it curves round through Bamra, as such a line would pass through several forest blocks of the Sambalpur and Hathibari ranges (Chichamura, Jhargati, Gharpati, Sangramul, etc.), in none of which have such rocks been noted (*cp.* p. 14).

73. Forming perhaps part of the above Rairakhol-Talchir area there are outcrops of pink sandstone in the north of Angul which are probably continued into the south of Bamra. They occupy the east of the Durgapur forest block, and are associated with a little laterite. The western part of the same block is granite or gneiss, and the surface is often covered with rounded quartz stones. In this forest the sandstones show Sal growth, whereas the western parts are mixed forest.

74. *Laterite.*—Laterite is said to occur at many horizons, being a superficial alteration of rocks under certain meteorological conditions. It thus sometimes assists in locating stratigraphical breaks in the absence of an unconformity. But most of the laterite is probably recent and still in course of formation. On the Neterhat plateau (Central tract) it is very free from silica, and contains a large excess of alumina and becomes *Bauxite.* It occurs largely in the Southern tract, chiefly capping hills and plateaux, but in Singbhum there is a thick deposit along some of the Saranda valleys of the amygdaloid type. Laterite occupies large areas about Khurda, and on it is situated the Jaimangal and other small forests. It extends interruptedly to Cuttack and into Athgarh and Dhenkenal, and north of Cuttack between Kapilas and Bysee, and at intervals to Bhadrak and

* *Gazetteer of Sambalpur,* p. 7. The authority for the statement appears to be derived from Ball, *Records Geol. Surv., India,* vol. x.

Balasore. Many of the railway stations along the East Coast Railway in Orissa are built of it. The Balasore laterite is more gravelly than that further south, and is apparently detrital. South of Khurda it extends to Tangi, though the hills are of gneiss. It is less common in other districts of the Southern tract. In the Lamal Junan block (Sambalpur range) it forms scarps and ridges well stocked with *Cleistanthus*, Bija and Sal, and it frequently caps the plateaux in Kalahandi, Patna and Borosambar.

75. It may be noted that laterite, when capping or mixed with other soils, usually has a distinctly good influence on forest growth, but where laterite and other formations run side by side (as in the case of the Athgarh sandstone) it is not possible to find any particular species occurring on one and not on the other.

76. Kunker is apparently a recent formation, often found in the older alluvium, but especially in the Southern area on igneous and gneissic rocks, of which it appears to be a product of the decomposition of the felspars under the influence of extremes of climate and defective drainage or at least, as near nalas, where there is an excess of water. Kunker soils in the forests are for some reason or other very poorly stocked. This effect may be purely mechanical; the kunker is partly dissolved in the rains and forms a cement between the particles of soil in the dry weather. *Soymida* and *Ischœmum* (*Pollinidium angustifolium*) are frequent species on kunker soils. Cotton soil (regur) is widespread in the Southern tract, characteristic species are given on p. 62.

77. PRINCIPAL FORMATIONS.*

Approximate Geological Age.		Formations represented.
Recent . .	— .	Newer Alluvium. Laterite (but see para. 74). Regur, Kunker, etc.
Pleistocene .	— .	Older Alluvium.
Tertiary .	Pliocene . .	Siwalik.
Secondary or Mezozoic	Cretaceous	
	Jurassic . .	Upper Gondwana: Rajmahal Traps, etc.
	Triassic . .	Middle Gondwana (see also note on p. 16).
Primary or Palæozoic	Permian . .	Lower Gondwana: Damuda, Talchir.
	Carboniferous	
	Devonian	
	Cambrian . .	Vindhyan (but azoic in our area).
Azoic . .	Algonkian .	Kadapah.
	Huronian . .	Dharwar.
	Archæan . .	Fundamental Gneiss.

* From Geikie, *Textbook of Geology*, p. 679, Third Ed., and Vredenberg, *Summary of the Geology of India.*



RAINFALL
OF
BIHAR & ORISSA
Scale 1″=64 Miles
NEPAL
UNITED PROVINCES
CENTRAL PROVINCES
MADRAS PRESIDENCY
BAY OF BENGAL
BENGAL
GORAKHPUR 50
BALLIA 41
GHAZIPUR 40
BENARES 40
MIRZAPUR 43
DARJEELING
JALPAIGURI 142
DINAJPUR 71
MALDA
MURSHIDABAD
BIRBHUM
BURDWAN 56
BANKURA 53
MIDNAPORE 60
SURGUJA 64
JASHPUR 64
RAIGARH 61
SARANGARH 54
RAIPUR 50
KALAHANDI 58
VIZAGAPATAM
GANJAM
. Amarkantak
TIRHUT
PATNA
BHAGALPUR
CHOTA NAGPUR
ORISSA
SAMBALPUR
REFERENCE TO NUMBERS
1 KARAIKELA
2 NILGIRI 68″
3 NARSINGHPUR 48″
4 BARAMBA
5 TIGIRIA
6 ATHGARH 54″
7 KHANDPARA
8 RANPUR
Inches of Rain shewn thus 61
Rainfall 60-80″
Rainfall 50-60″
Rainfall 40-50″

CHAPTER III.

CLIMATE.

General: 78–80; Seasons, 81; Rainfall, 82; Rainfall of Central tract, 83; Rainfall of Southern tract, 84; Average number of rainy days, 85, 86; Relative humidity, 87; Vapour tension, 88; Cloud, 89; Mean maximum temperature, 90; Mean minimum temperature, 91; Range of temperature, 92; Frost, 93–95.

78. Meteorological stations in India* have to be placed where there already exists an agency capable of taking the instrumental readings—that is, mainly, in the towns. They are not, therefore, well adapted, except in a very general way, for botanical purposes. None exists on the jungle-covered hills or at the tops of the mountains, nor are there paired stations inside and outside the forests. More may one day be done in this way with the aid of the Forest Department, but so far the establishment has been insufficient for the purpose. Even the existing data from towns are not always available in the best form for our purposes. Published results are nearly always means, but it is extremes that often have the largest bearing on vegetation, and such extremes, although not supported by figures, have to be referred to in the section on the character of the flora. Among such extremes may be mentioned years of extreme drought. Such droughts will kill large trees of some species, and the effects are not confined to the year of the drought, but, on account possibly of the death of the roots, will continue to show for two to three years. Means of temperature again do not show that several districts, especially those in the north of our area, and more rarely most districts of the Central tract, are subject to cold-weather frosts. Allied to climate in its effects are the hot-weather jungle fires, which have a very important bearing on the survival of species, so much so that their absence or frequency may entirely alter the character of a forest.

79. *Rainfall.*†—The attached rainfall map shows in blue approxi-

* The following (taken from *Met. Memoirs*, 1904) are the dates of establishment of some of the meteorological stations and their elevation (elev. of barometer cistern) above mean sea-level. Where two elevations are given, this is due to change in position.

Station.	Date.	Elevation (feet).	Station.	Date.	Elevation (feet).
Patna .	. 1867	170, 183 .	Ranchi .	. 1883	2128
Gaya .	. 1869	375 .	Hazaribagh	. 1867	1996, 2007, etc.
Purneah	. 1874	125 .	Balasore .	. 1883	56, 48, etc.
Darbhanga	. 1875	166 .	False Point	. 1865	15, 21, etc.
Sambalpur	. 1875	474, 486 .	Cuttack .	. 1867	80
Chaibassa	. 1883	760			

Other stations (without barometers ?) not recorded, or stations established since 1903.

† The rainfall figures in the tables have been taken from the *Monthly Rainfall of India*, 1922, published by the Provincial Governments, and issued by the Meteorological Department, 1922 (kindly lent by the High Commissioner for India). The normals are calculated up to 1918 inclusive only. District averages are based on more stations than are reproduced by me, and do not therefore always correspond with the average of my figures for stations. Figures are not exactly comparable, records at the different stations being for different numbers of years.

mately those regions where the rainfall is over 60″. The area so coloured to the north-west, along the Sameshwar Hills, in close vicinity to the Himalayas, will be seen in the chapter on the composition of the flora to have a special, chiefly sub-Himalayan facies, akin to that of the adjacent Nepal Mountains. This also applies to the north-east area, but that the latter lacks the special sandstone plants and more resembles the northern Bengal flora. A small portion of the north-eastern Santal Parganas, including the east of the Rajmahal Hills, properly belongs in climate to the north-east tract of the Northern area, although for convenience the whole Santal Parganas district is included in the Central area. The greater rainfall and relative humidity of parts of the Rajmahal Hills accounts for the presence of *Siphonodon* and a few other Himalayan species found nowhere else in the Central tract.

80. The Southern tract will be seen to have the greatest area with a rainfall of 60″ and over. In addition to the area coloured blue, parts of the Angul forests, Daspalla and Baud, have probably a rainfall of 60″ and a greater relative humidity than that shown for Angul station, and nearly the whole of the remainder of the Southern area with the exception of the Keonjhur plateau and perhaps the Sonpur-Patna belt has a rainfall of 52–58″. But not only is the rainfall and relative humidity high, but the mean minimum temperature is over 70°, and there is (with the few exceptions mentioned in para. 94) a complete absence of frost. The flora has, therefore, an abundance of species characteristic of warm humid climates, many of them common to Chittagong and Burmah. The high winter temperature probably accounts for the natural Teak in Kalahandi, and it may once have spread into the south of Puri, where planted Teak is doing well. The Sonpur-Patna belt, including part of Sambalpur and perhaps Kalahandi, has a more continental climate than the rest of the Southern tract, and many of the distinctive Southern tract plants disappear. The relative humidity is lower and the range of temperature in Sambalpur, although frost is absent, is greater than that of any other district excepting perhaps Gaya and Palamau.

81. The climate is of the monsoon type, and is characterized throughout the province by a dry and comparatively cool season from the middle of October to the middle of February, a dry and hot season from the middle of February to usually some time in May or June, and a warm wet season from June or July to September. The rainfall* is derived mainly from the Bay current of the monsoon, which in the north becomes deflected by the Himalayas and sweeps up the Gangetic plain, or further south is precipitated by the mountains of the Central tract, or those of Orissa, and thus the actual rainfall varies to a considerable degree according to the position of any place relative to the mountain masses and its proximity to the Bay. On this account there is a relatively wet belt along our eastern boundary, and on account of proximity to the Himalayas there is a second belt

* The small scale map (1″=64 miles) attached shows inches of rainfall (in bold figures) without fractions, the recording station, where named, being shown by a small circle.

close to the northern boundary which as it recedes from the Bay becomes less and less marked, whereas where the two belts intersect, *i. e.* in Purneah, there is the heaviest rainfall of the province, attaining an average of 82″ at Kaliaganj, which comes very much under the influence of the Himalaya. In this northern belt the fall rapidly slackens towards Darbhanga and Muzaffarpur, but again increases with proximity to the mountains in the north of Champaran. Owing to moist winds direct from the Bay becoming intercepted by the mountains of the south there is a large area of heavy rain also in the Southern tract, and probably the next highest rainfall to Purneah, or perhaps even higher, is that of the Simlipahar Mountains in Mayurbhanj, which attain 3550 ft. at Meghasani. There is, however, no meteorological station either here or on Parasnath, the highest mountain in the province, or indeed on the tops of any of the hill ranges. We know, however, that the fall in Mayurbhanj at Baripada, some 27 miles to east by north of Meghasani, reaches 62·8″, which is as much as Purneah town (61·7″) 40 miles south of the foothills of Nepal.

82. The rainfall in the northern area shows a fairly regularly graded distribution, as may be seen from the following table, in which the districts are enumerated from west to east, and the recording stations in each district from north to south.

(1) RAINFALL OF NORTHERN TRACT.

(a) *North of Ganges.*

Champaran and Saran.		Muzaffarpur.		Darbhanga.		Bhagalpur.		Purneah.	
Bagaha	62·5	Sitamarhi	50·1	Madhubani	50·9	Supaul	52·9	Kaliaganj	82·3
Bettiah	54·6	Muzaffarpur	48·0	Darbhanga	49·7	Madhepura	52·5	Araria	70·2
Motihari	52·7	Hajipur	45·2	Samastipur	48·6			Kisanganj	79·6
Barharwa	48·2							Purneah	61·7
Siwan	46·6								
Chapra	41·6								
District average	53·2 / 44·4		46·4		51·2		52·3		67·9

(b) *South of Ganges.*

Shahabad.		Patna and Gaya.		Monghyr.		Bhagalpur.		Santal Parganas.	
Buxar	40·7	Patna	46·7	Monghyr	48·4	Bhagalpur	47·0	Rajmahal	53·4
Arrah	43·7	Barh	43·0	Jamui	45·4	Bhanka	47·9		
Bhabua	42·4	Bihar	43·5	Sheikhpura	42·2				
Sasaram	44·3	Gaya	45·7	Gidhaur	45·1				
		Nawada	42·5						
District average	41·9		43·0 / 42·6		47·8		47·6		

It will be seen that the rainfall increases from west to east except, in Champaran, where the recording stations are affected by the nearer approach of the hills.

83. In the Central tract also there is a general average decrease of the rainfall from east to west, but here, as might be expected from the topography, the rule is subject to more exceptions. Not only

do places in the lee of hill ranges show a considerable decrease of rain, *e. g.* Godda on the west of the Rajmahal range is only 49″ compared with Pakaur at the eastern foot 60″, but the extreme western regions come under the influence of the vast elevated tract of the Vindhyan-Mahadeva mountains, which about Amarkantak* form an axis of minimum pressure towards which the two branches of the monsoon converge from the opposite coasts.† Here, therefore, in the extreme western hills of Palamau, Ranchi and Gangpur there is again a large increase of precipitation, very imperfectly shown by the figures available.

(2) RAINFALL OF CENTRAL TRACT.

(a) *Northern Districts.*

Palamau.		Hazaribagh.		Santal Parganas.	
Hussainabad	43·6	Chatra	49·5	Godda	47·3
Garwa	46·2	Giridih	49·6	Pakaur	60·1
Daltonganj	43·7	Hazaribagh	52·1	Dumka	56·6
				Madhupur	49·9
District average	44·9		50·4		54·1

(b) *Southern Districts.*

Western States.		Ranchi.		Singbhum.		Manbhum.	
Sirguja	64·4	Lohardaga	50·7	Chakradapur	52·5	Gobindpur	53·4
Jashpur	63·8	Ranchi	53·9	Ghatsila	57·9	Jhalda	54·4
Gangpur	60·5	Silli	50·6	Chaibassa	53·2	Purulia	54·1
		Chainpur	53·0				
		Tamar	50·4				
		Palkot	60·0				
District average			55·3		55·9		49·8

The elevation of Bisrampur, the capital of Sirjuga, is 1953 ft.; of Jashpurnagar 2576 ft. Both these states are now transferred to the Central Provinces. The rainfall of Neterhat will probably approach that of these two places or exceed them. Palkot is on the Ranchi plateau on the west and close to windward of the Jashpurnagar pats. Gangpur and the Kolhan portion of Singbhum fall better into the Southern tract.

84. The Southern tract, by reason perhaps of its greater hilliness, more forest, and especially by being more directly influenced by the Bay winds, is on the whole more rainy than the other two tracts. By reason of the great irregularity of the arrangement into states or districts, it is not possible to arrange the districts into east and west series, and here again, while recording stations occur on the low ground along the coast, there are none on the inner hills except that of Pal Lahara.

(3) RAINFALL OF SOUTHERN TRACT.

(a) *Western Districts.*—Sambalpur 61·9; Bamra—Deogarh 67; Rairakhol—Rampur 60·2; Sonepur 51·0; Patna—Bolangir 52·0; Baud 52·6; Kalahandi—Bhawanipatna 58·1.

* The position of Amarkantak has been shown on the maps attached.
† *Cp.* Blandford, *Met. Memoirs*, vol. iii, part 3.

(b) *Central Districts.*—Singbhum (Kolhan)—Goilkera 57·0, Monaharpur 62·7 (both on the railway); Anandpur 54·2; Bonai—Bonaigarh 63·7; Keonjhar 47·1; Pal Lahara 67·2; Talcher 52·3; Dhenkenal 58·0; Athmallik 54·2; Angul—Angul 48·8, Tikapara 53·1; Hindol 56·1; Daspalla—Kunjabon 53·2; Narsingpur 48·7; Athgarh 54·1; Nayagarh 56·0; Mayurbhanj—Baripada 62·8.

(c) *Coastal Districts.*—Balasore—Balasore 63·5, Bhadrak 60·3; Cuttack—Jajpur 60·1, Cuttack 60·8, Hukitola (False Point) 64·9, Kendrapara 59·8; Nilgiri 67·7; Puri—Puri 53·6, Khurda 59·2.

85. *Average Number of Rainy Days.**

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Bagaha	2	1	1	1	4	10	15	14	9	3	0	1	62
Bettiah	1	1	1	1	4	9	13	13	9	2	0	0	55
Sitamarhi	1	1	1	2	5	9	12	12	8	3	0	0	54
Muzaffarpur	1	1	1	1	4	8	14	13	9	3	0	0	56
Darbhanga	1	1	1	1	4	8	14	14	9	3	0	0	58
Supaul	1	1	1	1	5	9	15	14	10	3	0	0	61
Kaliaganj	1	1	1	3	7	14	18	17	12	3	0	0	79
Purneah	1	1	1	2	5	11	17	17	11	3	0	0	70
Buxar	2	1	1	0	2	8	14	13	9	3	0	0	55
Sasaram	1	1	1	1	2	8	14	14	10	3	0	0	55
Patna	1	1	1	1	3	8	14	13	9	3	0	0	55
Gaya	1	1	1	1	2	8	16	14	9	3	0	0	57
Monghyr	1	2	1	1	3	8	17	14	10	3	0	0	60
Gidhaur	1	1	1	2	2	8	15	15	11	3	0	0	60
Bhagalpur	1	1	1	2	4	10	15	13	9	3	0	0	61
Rajmahal	1	1	1	2	5	11	15	14	11	3	0	0	64
Daltonganj	2	1	2	1	2	8	16	16	10	3	0	0	63
Giridih	1	2	1	1	4	12	19	17	13	4	0	0	75
Hazaribagh	1	2	2	1	4	11	19	18	12	4	0	0	76
Godda	1	1	1	1	5	11	16	15	11	4	0	0	66
Dumka	1	2	1	2	5	12	19	18	13	5	0	0	79
Sargujah	2	1	1	0	1	9	20	19	9	3	1	0	69
Gangpur	1	1	2	1	2	10	19	18	10	3	1	1	70
Ranchi	1	2	3	2	5	12	19	18	14	4	0	0	80
Chakradapur	1	1	1	2	6	12	16	17	12	4	1	0	74
Chaibassa	1	2	2	2	6	11	17	17	12	4	1	1	75
Purulia	1	2	2	2	5	12	17	16	12	4	1	0	76
Sambalpur	1	1	2	1	3	10	19	17	12	4	1	0	72
Monaharpur	0	1	0	3	3	11	18	19	6	2	0	0	65
Pal Lahara	0	1	1	3	5	11	18	18	12	5	1	0	77
Angul	0	1	2	2	4	11	15	14	12	5	2	1	70
Baripada	1	2	2	4	7	13	17	16	13	6	1	0	81
Balasore	1	2	3	4	8	11	15	16	14	6	1	0	81
Cuttack	1	1	2	2	5	11	16	16	13	6	2	1	76
False Point	1	1	1	2	4	9	15	16	13	8	2	1	74
Puri	0	1	1	1	3	8	12	13	12	8	2	1	63

* From the *Meteorological Memoirs*, 1904.

A rainy day is a day in which ·1″ rain or more is recorded. It will be seen that the number of rainy days is not proportional to the rainfall. This is partly, but by no means entirely, due to the figures being less recent. As the figures are to the nearest whole number, the average of the year does not always agree with total of the monthly normals.

The above figures of rainfall and its distribution sufficiently show that every part of the province is well adapted to the growth of forest, though not forest of the most luxuriant type.

86. The total normal number of rainy days and the normal rainfall brought up to the year 1910* for a smaller number of stations is given below. The figures per month are not available.

	Normal Rainfall.	Rainy Days.		Normal Rainfall.	Rainy Days.
Motihari	55·57	59	Daltonganj	41·91	62
Chapra	42·30	52	Hazaribagh	52·59	75
Muzaffarpur	49·55	56	Dumka	56·21	78
Pusa	49·13	55	Ranchi	56·20	80
Darbhanga	51·09	59	Chaibassa	52·11	75
Purneah	61·72	70	Purulia	52·51	76
Buxar	41·09	53	Sambalpur	64·74	75
Arrah	44·95	55	Angul	47·04	72
Dehri	42·01	54	Balasore	62·09	77
Patna	47·98	56	Cuttack	59·30	74
Gaya	46·48	58	False Point	62·92	72
Monghyr	50·99	52	Puri	54·00	60
Bhagalpur	49·24	60			

87. *Relative humidity.*—The principal rain falls, as stated above, from June to September, but there are occasional showers towards end of December or beginning of January, and frequently heavy thunder showers in May, which tend considerably to raise the relative humidity of those months. In the months following on the cessation of the rainy season there are great differences between the temperatures and relative humidity of day and night, and very heavy dews occur which are of importance to the cold weather annuals.

In the following table the relative humidity is given in the same order as the rainfall for each month of the year. The recording stations are fewer.

* Calculated from (Government of India) *Indian Weather Review*, Annual Summary with figures of departures from normal, 1918. The normals are, however, only based on records *available up to 1910 inclusive.* The normal rainfall up to that date is therefore also given, and differs somewhat from figures in previous paragraph. The records of a few stations not available in 1904 have been added.

Relative Humidity.

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Gorakhpur*	82	72	57	53	63	78	87	88	84	77	76	81	75
Darbhanga	88	79	63	65	72	83	88	89	87	83	83	87	81
Purneah .	91	84	68	68	77	87	90	91	90	88	89	91	85
Buxar .	74	66	49	42	52	71	84	88	84	72	67	71	68
Patna .	78	69	52	51	64	77	86	87	83	74	71	75	72
Gaya .	75	69	55	51	58	73	83	86	82	73	71	72	71
Daltonganj	81	75	58	46	48	66	83	86	84	80	79	81	72
Dumka .	75	65	50	52	67	80	87	88	85	78	74	73	73
Ranchi .	65	60	45	42	51	72	88	89	84	70	63	64	66
Chaibassa .	78	72	61	57	64	74	86	87	86	80	78	79	75
Purulia .	73	65	55	54	66	79	88	90	88	78	70	69	73
Sambalpur	73	66	55	50	50	69	85	85	82	77	74	74	70
Angul .	80	76	67	67	67	78	85	86	86	79	73	79	77
Balasore .	81	77	77	75	75	81	86	87	87	83	80	78	81
Cuttack .	81	80	78	74	73	78	82	83	83	80	78	77	79
False Point	88	86	85	82	82	83	87	87	85	84	82	84	85
Puri .	82	81	84	85	85	85	86	86	85	81	78	77	83

88. The *normals of vapour tension* are given in the following table:†

Vapour Tension.

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Gorakhpur	35	36	41	55	73	91	97	96	91	72	50	37	64
Darbhanga	38	39	45	63	79	93	97	98	94	79	55	40	68
Purneah .	36	39	48	65	81	93	98	98	96	80	55	38	69
Buxar .	34	35	37	45	64	86	95	95	91	68	45	35	61
Patna .	36	37	41	54	75	92	98	98	94	74	50	37	66
Gaya .	35	38	45	59	77	91	94	94	89	69	47	34	64
Daltonganj	34	37	40	47	61	80	89	89	85	64	44	35	59
Dumka .	35	39	41	58	77	90	93	93	91	74	51	36	65
Ranchi .	31	32	34	43	58	74	79	79	75	60	40	31	53
Chaibassa .	38	41	47	64	75	85	86	87	87	72	50	38	64
Purulia .	36	37	44	56	75	88	91	91	89	70	45	34	63
Sambalpur	42	44	48	60	71	84	89	88	88	74	52	41	65
Angul .	44	51	57	71	82	87	89	89	90	74	50	43	69
Balasore .	44	51	68	83	92	95	95	95	95	81	56	42	75
Cuttack .	48	57	71	84	91	92	90	91	90	80	58	45	75
False Point	55	66	82	92	100	99	96	96	95	87	65	51	82
Puri .	56	66	83	91	101	100	97	97	96	85	64	51	82

* Gorakhpur is not in our area, but is shown for comparison as the nearest recording station to the Gandak, on the west of which it is situated. The highest relative humidity is seen to be in the north-east corner (Purneah), and on the sea coast (False Point, Puri, etc.).

† The figures represent hundredths of an inch. The original figures (*Memoirs of the Indian Met. Dept.*, vol. xxii, part 3, 1914, being given to three places of decimals the averages do not in all cases quite agree with the year's average.

89. *Monthly and Annual Normals of Cloud.**

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Gorakhpur	20	22	17	18	20	48	64	65	46	17	7	11	30
Darbhanga	18	17	12	14	23	56	72	71	51	18	6	8	31
Purneah .	16	16	13	24	37	65	71	73	57	23	7	8	34
Buxar .	24	25	19	16	18	49	73	73	52	22	11	14	33
Patna .	21	25	17	15	20	54	82	85	60	22	11	11	35
Gaya .	23	26	21	20	25	51	68	68	49	27	15	16	34
Daltonganj	20	20	15	17	15	41	58	56	40	19	11	12	27
Dumka .	17	19	14	18	30	56	70	69	55	24	11	11	33
Ranchi .	23	26	18	19	23	58	83	83	61	31	16	16	38
Chaibassa .	17	22	18	17	23	55	73	71	56	29	17	15	34
Purulia .	22	23	17	22	24	50	67	64	53	22	12	13	32
Sambalpur	21	23	19	22	29	64	82	80	59	29	18	18	39
Angul .	21	32	30	23	20	57	62	56	45	29	12	16	34
Balasore .	15	21	19	26	33	53	61	59	51	30	17	14	33
Cuttack .	21	27	30	36	45	69	74	73	61	37	25	23	43
False Point	26	34	42	54	61	78	84	83	73	47	34	27	54
Puri .	15	21	27	35	43	62	70	69	56	32	20	14	39

90. *Mean Maximum Temperature,* °F.

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Gorakhpur	73	77	90	100	101	97	91	90	90	89	82	74	88
Darbhanga	73	77	88	96	96	92	89	89	89	87	82	75	86
Purneah .	74	78	90	97	95	92	90	89	89	88	82	76	87
Buxar .	74	78	90	100	103	98	91	89	90	90	84	76	89
Patna .	73	78	90	100	100	96	91	89	90	88	82	74	88
Gaya .	75	80	93	103	105	100	92	90	91	90	83	76	90
Daltonganj	75	79	90	101	107	101	91	89	90	89	83	77	89
Dumka .	75	80	91	100	99	94	89	88	89	88	82	76	88
Ranchi .	74	77	87	96	99	92	84	83	84	83	78	73	84
Chaibassa .	80	84	95	103	104	97	89	89	89	89	84	79	90
Purulia .	77	81	93	102	102	97	90	89	89	89	84	78	89
Sambalpur	82	87	96	104	107	98	87	87	89	89	84	80	91
Angul .	82	87	95	101	104	95	88	87	88	89	84	79	90
Balasore .	81	85	92	97	97	93	89	88	89	88	84	80	89
Cuttack .	84	89	97	102	101	96	90	89	90	90	85	82	91
False Point	79	82	87	89	91	90	87	87	88	88	83	78	86
Puri .	80	83	86	88	90	89	88	88	89	89	85	80	86

* Cloud is usually estimated according to a scale 0–10, 0 being a clear sky, 10 a sky entirely overcast. The meteorological records show it on the scale to one place of decimals, which I have converted into percentages of an entirely overcast sky.

91. *Mean Minimum Temperature*, °F.

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Gorakhpur	49	52	62	72	77	79	79	79	78	70	58	50	67
Darbhanga	51	53	62	71	76	79	80	79	79	73	61	53	68
Purneah .	48	51	60	70	74	77	79	78	77	71	59	49	66
Buxar .	50	54	63	74	79	81	79	78	78	71	60	51	68
Patna .	51	54	64	73	78	80	80	79	79	72	61	52	69
Gaya .	51	56	66	75	80	81	79	78	78	71	59	51	69
Daltonganj	47	51	59	70	79	81	78	77	75	66	53	46	65
Dumka .	51	56	65	74	77	78	78	77	77	71	60	51	68
Ranchi .	51	55	63	72	75	75	73	73	72	66	58	51	65
Chaibassa .	54	59	67	75	79	79	77	77	76	70	60	53	69
Purulia .	54	58	66	74	77	79	77	76	76	70	60	53	68
Sambalpur	55	60	67	75	81	81	77	77	77	72	61	54	70
Angul .	56	61	67	74	78	78	77	77	76	71	60	55	69
Balasore .	56	61	69	76	79	79	78	78	78	73	62	56	70
Cuttack .	60	65	72	78	80	80	79	78	78	75	66	59	72
False Point	59	64	72	77	80	80	78	78	78	74	65	57	72
Puri .	64	69	75	79	81	81	80	79	80	77	69	62	74

92. The *absolute maximum, absolute minimum and range of temperature* previous to 1903 is recorded for the following stations:

Northern Area.

	Maximum.	Minimum.	Greatest range.
Darbhanga .	107·4 in May .	38·3 in January .	51·7 in March.
Purneah .	109·9 ,, April .	34·7 ,, February .	59·4 ,, ,,
Patna . .	114·4 ,, June .	36·4 ,, January .	61·3 ,, ,,
Gaya . .	116·2 ,, ,, .	38·9 ,, ,, .	56·0 ,, May.

Central Area.

	Maximum.	Minimum.	Greatest range.
Ranchi .	110·3 in May .	37·9 in January .	54·9 in March.
Chaibassa .	117·8 ,, ,, .	42·9 ,, December and January .	57·6 ,, ,,

Southern Area.

	Maximum.	Minimum.	Greatest range.
Sambalpur .	117·3 in May .	40·1 in December .	62·6 in March.
Balasore .	116·0 ,, ,, .	45·4 ,, January .	49·0 ,, ,,
Cuttack .	118·0 ,, ,, .	48·6 ,, ,, .	51·3 ,, February
False Point .	108·5 ,, ,, .	45·9 ,, ,, .	45·7 ,, ,,

93. *Frost.*—There are no figures available as to actual grass temperatures. The absolute minimum recorded in para. 80 must be temperatures in the screen, as I have recorded 2° frost on the roof of my tent as far south as Singbhum, while Hamilton* states that "hoar frost is

* Walter Hamilton (not Dr. Francis Buchanan, better known as Buchanan-Hamilton). Hamilton's "Bahar" (in *Description of Hindustan*) embraced our Northern and Central areas *without Purneah and Singbhum.*

found in some mornings in Purneah, which occasionally is so extreme as to injure some crops, especially the pulse." He also says, "During the cold season a blighting frost is sometimes experienced in the Bahar and Benares provinces." Frost is not believed to occur in the northern parts of Purneah or in the east of the Santal Parganas (coloured blue on map). The area of greatest frost corresponds approximately to the area coloured yellow on the rainfall map, which also contains those places where the tension of water vapour in January is least (see para. 88). In Palamau frost is frequent. In the Saidope forest and near the Koinari River, practically in the plains, the frost damage is sometimes great. On the elevated pats it is naturally still more severe. Where the original forest has been maintained but little damage is done, but especially in depressions in the open the effects of frost in January and the strong winds in the hot season make such places exceedingly difficult to reafforest. In the course of time, if protected from fires and grazing, the natural forest would probably reassert itself by very gradually spreading from the edges of existing woods.

94. The Southern area is practically free from frost, but in Singbhum frost has been noted at various times from December 17th to January 31st. They are slight at ordinary elevations, but it has been noted that Sal seedlings on the edges of grass tracts (the grass due primarily to cultivation) at an elevation of 2800 ft. in the Karampoda forest have been repeatedly cut back by frost.

95. The comparatively frost-hardy species in our Northern and Central tracts appear to be *Mallotus philippinensis*, *Bauhinia retusa*, *B. purpurea*, *Eugenia obovata*, *Bombax malabaricum*, *Garuga pinnata*, *Embelia robusta*, *Aegle marmelos*, *Stereospermum suaveolens*, *Emblica officinalis*, *Lagerstrœmia parviflora*, *Gardenia turgida*, *Carissa paucinervia*, *Salix tetrasperma* and the shrubs *Glochidion multiloculare* and *Woodfordia floribunda*. To a less extent *Terminalia tomentosa* and *Butea frondosa*. The Sal, *Dillenia* and most other species which are common in the Central tract and Southern tract are frost-tender.

CHAPTER IV.

GENERAL CHARACTER OF THE FLORA AND BOTANICAL FORMATIONS.

Botanical provinces, 96 ; Distinctive characters of Bihar and Orissa, 97 ; Mainly tropophilous, thorn woodland, induced scrub, 98 ; Principal seasons of leafing and flowering, bulbous plants, 99 ; Monsoon period, herbaceous climbers, 100 ; Dominant families, 101 ; Distribution, 102 ; Effects of fire on distribution, 103.

Northern Tract: Gangetic Plain area, 104 ; Long under cultivation, 105 ; Little natural growth, 106 ; Crops, 107 ; Higher cultivated lands, wild flora, 108 ; Semi-natural forest, 109 ; Swamps, 110 ; Aquatics, 111 ; Transition between swamp and aquatic flora, 112 ; Rice-field flora, 113 ; Natural woodland, 114 ; Khair-Sissu forest, 115 ; Sameshwar Hills, 116 ; Species characteristic of Sameshwar Hills and Lower Himalaya also found in Central and

Southern tracts, 117 ; Species characteristic of Central tract found in the Sameshwar Hills, 118 ; Species normally common to sub-Himalaya, Central and Southern tracts, 119 ; Purneah, 120 ; Grass lands of Northern tract, low-level savannahs, 121 ; High-level savannahs, 122 ; Other herbs of the grass lands, 123 ; First trees to appear in grass lands, 124 ; Effects of heavy grazing, 125.

Central Tract: General, 126 ; The Sal tree, 127 ; Trees on dry hills, white bark a xerophilous structure, 128 ; chasmophytes, 129 ; *Ficus*, 130 ; Other xerophytes, milky juice, 131 ; The Sal formation, 132 ; On trap and laterite, 133 ; On quartzite, limestone and cotton soil, 134 ; Dependence on lie of the strata or plane of bedding, 135 ; Valley type Sal, 136 ; Associates in valley type, 137 ; Associates in hill type, 138 ; Mixed forests, 139 ; Terminalia, 140 ; Dry type of mixed forests, 141 ; *Hardwickia*, 142 ; Khair type, 143 ; Evergreen type, 144, 145 ; Grass lands of Central tract, 146 ; Flora of the *páts*, 147 ; Endemic species, 148 ; The *páts* a connecting link between South India and the Himalaya, 149 ; Interesting species of the *páts*, 150 ; Flora of Parasnath, 151.

Southern Tract: General, 152 ; Sal, Teak and Bamboo, 153, 154 ; Thorny bamboo formation, 155 ; male bamboo, 156 ; Mixed forest, 157–162 ; Chittagong and Himalayan element, 157 ; Drier mixed forest, 158 ; Laterite and sandstone, 159, 160 ; Induced scrub, 161 ; Evergreen forest, 162 ; Coastal tracts, sand flora, 163 ; Mangrove swamps, 164, 165 ; Common characteristics, 166 ; Vivipary, 167 ; Drift seeds, 168.

Plant Communities : Species in a formation often independent of one another, 169 ; Easier to classify habitats than communities, latter very numerous, 170 ; Classification of habitats, 171 ; Allied species usually in different habitats, 172 ; Exceptions, 173 ; Temperate families, 174 ; List of trees and shrubs common to the Central tract and sub-Himalaya, 175 ; Table of habitats or plant associations, 176 ; Number of genera and species of each family, 177.

96. In the province of Bihar and Orissa as at present constituted are included parts of four botanical provinces of Hooker and Thomson, viz. : (1) the lower part of their province of the Upper Gangetic Plain ; (2) a small part (the district of Purneah only) of Bengal ; (3) the whole of their province of "Bahar" excepting a few native states recently transferred to the Central Provinces ; (4) the northern part of the province of Orissa. Our Northern tract is in the first two, the Central tract practically corresponds to their botanical province of Bahar, and the Southern tract is in the last.

97. In Sir J. D. Hooker's sketch of the flora of British India (1904) he makes nine botanical provinces of the whole country, including Ceylon, Burmah and the Malay Peninsula. Our province falls into two of these. The Gangetic Plain area and the low country of Orissa north of the Mahanadi lies in his Gangetic Plain province, and the remainder falls into his large Deccan Province. Some authors make many more provinces, but these are chiefly founded on differences of the topography and climate. A true botanical province only arises when the whole is characterized by the more or less general presence or absence of particular families, genera or endemic species. Bihar and Orissa as a whole is characterized by the complete absence of *Cupuliferæ*, a general scarcity of laurels and myrtles, and by few, or very few, *Ranunculaceæ*, *Magnoliaceæ*, *Cruciferæ*, *Guttiferaceæ*, *Rosaceæ*, *Umbelliferæ*, and comparatively few *Orchidaceæ*. Further, except for the genus *Ficus* it possesses comparatively few of the *Urticales*. On the other hand it possesses marked positive features in the presence, practically throughout, of the Sal tree (but no other Dipterocarp) and in the almost general association with the Sal in

large numbers of individuals, if not of species, of *Terminalia*, *Anogeissus*, *Bassia* (the Mohwa), *Butea*, *Scleichera*, *Rubiaceæ* (notably *Gardenia* and *Wendlandia*), *Acanthaceæ*, *Bauhinia*, *Diospyros*, *Zizyphus*, *Cleistanthus*, *Nyctanthes* and, except in the Gangetic plain, of the bamboo *Dendrocalamus strictus* and of the grasses *Ischæmum angustifolium* (Sabai grass) and *Heteropogon contortus* (Spear grass). The *Anonaceæ* are also well represented.

98. The general character of the vegetation is tropophilous, and there is no true rain forest in the province. The distribution of thorny species is adverse to Schimper's theory that thorn woodland is essentially a formation due to climate. As suggested in my *Forest Flora*, it appears here as rather the effect of selective cutting and browsing. In the pieces of semi-wild jungle of Purneah (one of the wettest districts, see para. 82) thorny species are abundant, and the very thorny *Flacourtia sepiaria* is one of the commonest in the type of heavily browsed scrub jungle which I have termed Induced Scrub. In this area also the prickly *Cæsalpinias* and Acacias are frequent, *A. concinna* sometimes forming a small tree. *Mimusops hexandra* is found with large blunt thorns, though it is thornless on the dry sandstones of the Central Provinces. It has been noted that the thorns of *Vangueria spinosa* are nowhere so formidable as when the tree is rapidly growing in the more humid jungles. In the Central tract the Khair (with stipular prickles) appears almost entirely due to the human factor (see para. 143), as do the *Zizyphus* tracts. The Induced Scrub, again, of the Southern tract bears no relation to the dryness of the locality, but rather to its accessibility to heavy hacking and grazing with the concomitant selection of the unarmed species to the benefit of the armed. And this Induced Scrub is gradually giving way to less thorny species with protection of the forests. On the other hand the dry hills of the Central tract have comparatively few thorny species, but are rather characterized by such xerophytic characters as succulence, thick branches, absence of leaves and white bark (see para. 128). The thorny species, such as *Gardenia turgida*, are most formidable when young and liable to be browsed.

99. Towards the beginning or middle of the hot season the forest is for the most part nearly leafless, but, contrary to what might be expected, the majority of the deciduous trees are in leaf again well before the monsoon. The hot season is the best one for the flowering of woody species, and the worst month is January. On the other hand a large number of herbs or suffruticose perennials flower in the cold season. The hot season, after the jungle fires and at the break of the monsoon, is the period for a quantity of bulbous and rhizomatous *Liliaceæ*, *Amaryllidaceæ*, *Soitamineæ*, etc., to send up their scapes and flowers, many of which are very beautiful. The leaves of these and other species form a characteristic monsoon undergrowth.

100. The monsoon period is further characterized by the rapid production of shoots and leaves of numerous suffruticose or herbaceous climbers such as *Dioscorea*, *Asparagus*, *Smilax* and *Ipomœa*, by the rapid growth or production of new leaves and shoots on both evergreen and deciduous trees and shrubs, and even undershrubs (such as

Petalidium), by the growth of innumerable annuals which either flower during the rains or after their cessation, and by the flowering of *Scitamineæ*, ground Orchids (epiphytic orchids mostly flower in the hot season), several *Liliaceæ* and *Tacca*, and also the rapid production of new shoots of the perennial grasses and bamboos, which mostly flower in the cold season. The result of monsoon activity is to make the forests, which in the hot season are easily traversable, difficult to walk through and still more difficult to see through, and the open country green with crops or tall grasses and other herbs, which before the rains is brown or bare.

101. The dominant families according to mere number of species are in the following order :*

1. *Leguminosæ.* 2. *Gramineæ.* 3. *Cyperaceæ.* 4. *Compositæ.* 5. *Euphorbiaceæ.* 6. *Acanthaceæ.* 7. *Rubiaceæ.* 8. *Labiatæ.* 9. *Scrophulariaceæ.* 10. *Convolvulaceæ.* 11. *Urticaceæ* (in the larger sense). 12. *Verbenaceæ.*

The enumeration of the ten most prevalent families (according to number of species) is the method adopted by Hooker in the abovementioned sketch. Until, however, we have complete accounts of the flora by districts, such as Prain's census of the flora of the Sundribans, it is almost useless to apply the system to subdivisions of a province. In our case, for instance, the grasses of the Central tract would appear to be far more numerous than those of the Northern or Southern tracts. This is merely due to the area having been more intensively worked.

102. In the body of this Flora, instead of recording the distribution of species by subdivisions or sub-areas, it has been considered preferable to name each district (administrative) from which there is a record of the occurrence of a species, or sometimes even the actual locality. There are several reasons for this, the chief being that our knowledge of the distribution of so many species is still very imperfect, and deductions from such imperfect data are apt to be misleading. It gives, for instance, a very imperfect idea of the distribution of *Didissandra lanuginosa* to quote Bihar or Chota Nagpur (or whatever subprovince or subdivision might be adopted) when it has only been collected or observed once or twice in a single district and near the same spot at 3000 ft. elevation. A few years ago it would have been assumed that many of the species here recorded from the province did not occur in Bihar and Orissa. For similar reasons, viz. the imperfection of available data, until the *Flora of Madras* has been completed, the flora of the Central Provinces and other adjacent and more remote areas have been more fully investigated and compiled, it is considered premature to show in detail or by numbers the spread of our species into other areas. It appears from the distribution notes in the following pages that the original barrier of the Gangetic Sea has been bridged partly *viâ* Chittagong and Orissa, as well as in north and south directions. Nowhere, however, have the *Cupuliferæ*, *Juglandaceæ* or *Betulaceæ* succeeded in crossing to the peninsula of

* A list of all the families with the approximate number of their genera and species is given in para. 177.

India. In all problems of distribution bearing upon our area, the very serious disturbances due to the action of man (*cp.* para. 98) will have to be taken into account. The effects of fire are especially important (see para. 103).

With such an immensely old land surface as that of the Indian Peninsula, with the majority of the species probably immensely old, and with no serious obstacles to their distribution, their occurrence indeed in different localities of a province is almost entirely a question of similar climate and soil. And by climate must here be included the very local climatic conditions of environment due to the position of a plant in a valley in contrast to one on a hill, or in the shade of other trees, as compared to one in the open. As insolation is an essential factor of climate, the local climate in the shade of a mango *tóp* is radically different to the climate beyond its shade. And thus a plant species found in the open in the humid climate of Purneah may not be found in the Central tract, but may recur on the mountains of the Southern tract under perhaps partial shade, or it may be found in ravines in the Central tract, and so in numerous other instances. But although many species thus find approximately similar conditions and recur in separated districts, and the isohyetal lines which, running through the hills of Northern Champaran, Southern Nepal, and Purneah, leave our province and curve round through Bengal, return to it again in the mountains of the Southern tract, they follow a different course to the isothermal lines, and these again vary much in direction at different seasons. So that taking these two factors alone it is impossible to reproduce exactly the same conditions in different parts of the province. Thus, although many species may be the same at widely separate points, with approximately equal humidity, the whole plant community is found to differ. Elastic species, like Sal and Saj, are found in many different plant communities.

103. *Effects of fire on distribution.*—Speaking generally the effect of hot-weather fires is gradually to transform forest to grass-land. This is done by repeatedly killing off young growth of all kinds, including the young branches of trees to a considerable height, and thus letting in the light favourable to strong-growing grasses which, in their turn, suppress tree reproduction and form every hot season dry fuel for the flames. The trees are themselves not killed by the fires if they have survived to the sapling stage. Where complete fire protection cannot be ensured the early intentional burning of the forest, when much of the heat is rendered latent by the large quantity of green material in the undergrowth as well as its intensity being initially less under the different climatic conditions (strong westerly hot-weather winds do not usually set in before March), will preserve the forest as such, but may alter its composition. Firing of any kind is inimical to evergreen forest. Very few evergreen species are at all fire-hardy. *Symplocos racemosa* is somewhat. But some deciduous species, the Sal especially, will thrive under a systematic *early* burning and gradually spread. Though the outermost seedlings of a clump get burnt to the ground they will send up a shoot in the ensuing hot

ason, and those further inside the clump, or close to a parent tree, ill get less and less burnt so that even an isolated tree will give rise ı the course of years to a cone of young growth which gradually ılarges. Where fire protection is absolute on the other hand, vergreen forest will in the more humid situations encroach upon ıe Sal area. Evergreen forest was at one time, therefore, probably r more extensive than it is at present, not only on this account, but om the higher altitudes of the mountains, and it is the evergreen rests which support the larger number of species. On the other and it is probable that a large number of the bulbous and rhizomatous erbs, which flower after the fires have removed cover, owe their adual evolution to annual burning. Some of the species, *e. g. neilema scapiflorum, Crinum latifolium,* species of *Pancratium, ypoxis aurea,* etc., etc., are rarely found in evergreen forest. The warf shrubs *Grewia sclerophylla, Grewia sapida, Ochna pumila, rythrina resupinata, Careya herbacea,* etc., may also have evolved ı response to the same cause.

Flora of the Northern Tract.

104. The Gangetic Plain area in view of its geological history might e expected to, and does in fact, separate very distinct floras. It onstitutes the greater part of our Northern tract. It cannot itself e separated as a distinct province by the absence of the Sal tree, ecause absence of the latter is due to local factors, including exterınation by man. As a matter of fact, Sal does occur in patches on ising ground in the heart of the Northern tract as in Bhagalpur, both orth and south of the Ganges.

105. There are, to my knowledge, no records of the original flora f the greater part of the Gangetic Plain. Though we know from lamilton that parts of it were covered with extensive Sal forests, etc. nly a century ago, the bulk of the Gangetic Plain must have been ighly cultivated for an immense period. Gotama Buddha preached ı Magadha (Bihar) about 500 B.C., and Megasthenes was ambassador t the court of Chandra Gupta at Pataliputra (Patna) some 300 B.C., nd it is suggestive that Asoka, king of Magadha 264–227 B.C., ssued edicts for the planting of trees for *shade !*

106. The plain now possesses very little natural growth except in he marshes, which form a distinct, scattered formation.* Omitting or the present the very distinct Northern Champaran (Sameshwar) lills and Northern Purneah, there are roughly four classes of land 1) The open cultivated lands; (2) small remnants of the forest ith their original constitution usually much altered by human gency; (3) the swamps; (4) the grass lands. To these a fifth

* A "formation" is a community of plants of more or less the same facies. his facies depends on climate and soil, and thus may be distinguished "climatic r district" formations and "edaphic or local formations." Schimper states at in each formation one species of plant, or a group of species, is characteristic; lants that merely occur sporadically are unessential to the formation, and comıoner subsidiary constituents can only give a different facies to the formation. le would probably have included the whole Sal area in one formation. We ave to regard it as consisting of several, or at least of several associations.

class, the *reh* lands, might be added. Commonly cultivated trees, sometimes forming small plantations (tóps) or groves, are mango, sissu, jack (*Artocarpus integrifolia*), *A. lakoocha*, bael, custard apple and bullock's heart, guava, *Mimusops elengi*, and rarely *M. hexandra*, *Elæocarpus ganitrus* and (Purneah) *E. floribunda*, *Sapium sebiferum*, mulberry, and bamboos (see also para. 20 relative to the limestone belt).

107. The crops are usually classified by the season in which they are reaped, being either *rabi*, reaped in spring, *bhado* or *bhadoi*, reaped in August and September, and *aghani*, reaped in winter. The soils are variously classified in different districts.

The chief crops are rice (both aghani and bhadoi), indigo (cut July or August, with a second cutting in September), maize, marua (*Eleusine*), millets, sugar-cane, wheat, barley, oats (all three harvested in spring), arhar (*Cajanus*), urid and mung (spp. of *Phaseolus*), janera (*Sorghum*), tobacco (especially in Tirhut*), oil seeds (*sesamum*), masuri dal (*Ervum lens*), and, less important, khesari dal (*Lathyrus sativus*), kodo (*Paspalum*), and others. Formerly the poppy was largely grown. Towards Purneah, where the rainfall is heavier, jute is grown.

108. The distinctive character of the wild flora of the higher cultivated lands is the presence of many European genera (see list on p. 65), and is due to the marked cold season or possibly also to direct seeding from the Himalaya. *Fragaria* and *Potentilla* occur in damp places under shade, but not in the cultivated area. Hooker refers to a *Veronica* and *Potentilla* on the banks of the Sone, no doubt *V. anagallis*† and *P. supina*. Hamilton refers to *Cannabis sativa* as wild in Bettiah. The rice-land flora of the Northern tract does not, so far as I am aware, differ much from that of the rest of the province.

109. In addition to Sal which occurs in small outliers on rising ground, the patches of semi-natural forest contain *Flacourtia cataphracta*, *F. Ramontchi*, *Miliusa*, *Putranjiva*, *Terminalia belerica*, *Albizzia stipulata*, *Grewia Hainesiana*, *Aegle marmelos* (Bael), *Litsæa polyantha*, Sissu, *Anthocephalus cadamba*, occasional *Pterocarpus marsupium* (a tree of the Central tract), *Cæsalpinia sepiaria*, *Phyllanthus emblica* (*Emblica officinalis*), *Hymenodictyon* (also chiefly a tree of C.T.), Simal (*Bombax*), *Pongamia glabra*, *Streblus asper*, and in the moister districts *Trewia nudiflora*, Celtis, *Alstonia scholaris*, *Eugenia jambos* (Rose-apple), *Salix tetrasperma*, *Cordia myxa*, *Vitex leucoxylon*, *Sapium sebiferum*. The following smaller trees or shrubs are also common:—*Vangueria*, *Cæsalpinia crista*, *Antidesma ghæsembilla*, *Solanum indicum* (and in Purneah *S. torvum* and *S. ferox*), *Murraya Kœnigii* (bakaina), *Adhatoda vasica*, *Ichnocarpus frutescens*, *Breynia rhamnoides*, *Cassia sophera*, *Randia dumetorum*, and many others. For a list of species peculiar or characteristic of the jungles of Purneah see p. 54.

Streblus asper is exceedingly abundant, as well in hedges in the

* Tirhut used to include the present districts of Muzafferpur and Darbhanga.

† *Veronica agrestis* is also frequent in the United Provinces at no great distance from the Sone. As regards the *Potentilla* Anderson, who had probably seen Hooker's specimen, gives *P. supina* as found along the Sone.

fields as in the semi-jungles, from a small exceedingly dense rigid almost thorny bush, closely browsed by goats, to a tree. As the intensity of the cultivation diminishes towards the Nepal frontier and Sikkim Tarai, and the rainfall also increases, the semi-natural forest and induced scrub passes into Sal or evergreen forest.

110. The swamps form a conspicuous feature of the Northern tract, but I have had little opportunity of studying them. In Monghyr, north of the Ganges, is a large shallow lake, the Kabar Tal, and the largest of the Muzafferpur lakes is the Tal Baraila. The marsh flora comprises woody as well as herbaceous plants, and even trees, *e. g. Barringtonia*, but these are sometimes survival species, and are found in more abundance in the evergreen forests of neighbouring areas.

Rosa involucrata (Koya), said to occur in large quantities in some places along the water channels of the Northern tract, occurs in the Central and Southern tracts only along rivers *in the forest*. Conspicuous along the chaurs and dhars (p. 5) is *Tamarix*, Hijal or Hyal (*Barringtonia*), *Lippia geminata*, the Reed (Narkat, *Phragmites*), Kasi (*Saccharum spontaneum*), of which Hamilton speaks of two varieties probably due to locality. In addition to these two varieties of Kasi, Hamilton also refers to the Kangra and Ikri as two separate species; the former is a name used for both *S. spontaneum* and *S. arundinaceum* (or *S. procerum*, if this is considered distinct), and Ikri is similarly applied to both these species, but rather to the prepared culms for walls than to the plant. I have only seen the *S. arundinaceum* in Purneah and eastwards. In swampy localities at a further distance from the actual water are large masses of the *Vetiviera*, of which the fragrant root is called "kaskas," the plant in flower is called "siki," the leaves "katra" (used for thatch), and the reedy part of the stem which is also used for making the walls of houses is called "birna." In the jheels are also Typha and the kesari (*Scirpus grossus*), a sedge 4–6 ft. high, of which the black tubers are eaten and the stems used for mats, and large species of *Cyperus*. Wet grass lands and margins of jheels also bear the beautiful tropical gentian (*Exacum tetragonum*, and more rarely *E. teres*). *Melastoma malabathricum* with large handsome rose-coloured flowers with yellow stamens is common. *Osbeckia rostrata* and *O. nepalensis* I have only seen in the north of Champaran.

111. The fresh-water aquatic formation is apparently remarkably uniform throughout the province, and also possesses many genera and even species which spread into temperate climates and are nearly cosmopolitan. This is no doubt due to the more uniform conditions of aquatic life as compared with sub-aërial. In Bihar and Orissa frost never lasts long enough to form a coating of ice on water if only a few inches deep. Aquatics show a preference according to species for (*a*) still water, (*b*) running water. Still-water plants are either floating or submerged, those of running water usually submerged and generally with much cut or riband-like leaves. Those with the leaves entirely or mainly emergent I have included under marsh plants. Of *Nymphæaceæ* (water-lilies) *Euryale ferox* appears confined to the Northern tract, and has so far only been found in Purneah, but the

species of *Nymphœa* are general as is *Nelumbium*, the sacred lotus. They have usually tuberous rootstocks and flower in the r.s. and h.s. *Nelumbium* has leaves floating and also exserted 1–2 ft. above the water. Species of *Limnanthemum* (*Gentianaceæ*) resemble the water-lilies in habit and shape of the leaves; they are common. *Trapa* (*Onagraceæ*), *Hydrocharis asiatica*, *Ottelia* and the grass *Hygrorrhiza* have also floating leaves and are common. All the above prefer still water. Two species of *Potamogeton* occur with floating leaves; other species are entirely submerged, with very numerous small or filiform leaves, *e. g. P. pusillus* and *P. pectinatus*, which are distributed throughout the northern temperate regions, and the latter also in Australia. Other submerged aquatics of the *Naidaceæ* and *Hydrocharitaceæ* are common, and the interesting *Cryptocoryne*, a submerged aroid in running water with grass-like leaves, which is equally at home on the sand or gravel after the water has subsided. Another aroid, *Pistia*, is a free floater with the habit of *Salvinia cucullata*, the latter a common water-fern in the rainy season. *Salvinia natans* so far is only recorded from the districts with a warmer winter temperature (Purneah). Both these water ferns as well as *Pistia* prefer water fairly warm and still backwaters, but they are often swept down the rivers in flood. *Lemna* is common on still waters or half stagnant water, and *Wolffia*, the smallest known flowering plant, is common in adjacent Bengal and no doubt in our province but it has not been collected. *Characeæ* (highly developed *Algæ*) are frequent but they are not dealt with in the Flora. Ainslie (*Materia Medica*) speaks of *Vallisneria alternifolia* and *Chara* being used for refining sugar in South Bihar; Hooker says *Chara* and *Zanichellia*. But there appears to be no particular virtue in these plants. *Hydrilla*, *Vallisneria spiralis*, etc., appear to be all used indiscriminately in a layer at the top of the refining vessels, through the tapering lower end of which the molasses slowly trickle while the sugar crystallizes at the top. The layer of water plants appears to function in keeping the top of the crude sugar moist, and water may be added to the top of the layer of weeds from time to time.

112. The true aquatic flora passes into that of the marshes by imperceptible steps. Some species like *Sagittaria* have long strap-shaped or riband-shaped leaves in deep running water, slender lanceolate blades in shallower water and erect sagittate leaves exserted from the water in marshes. The *Onagraceæ* in our area are chiefly marsh and water herbs. *Jussiæa repens* has long stems floating on the water, supported by white vesicular roots, but also creeps on the margin, *Trapa* is entirely aquatic, other species of *Jussiæa* and *Ludwigia* are erect in marshes and ditches. In the nearly allied family *Lythraceæ* the genus *Ammanina* (including *Rotala* and *Nesæa*) is very common in the marshes, not only in the Northern tract, but throughout the provinces, not only in natural marshes, but also in the rice-fields.

113. The rice-field wet flora differs somewhat from that of natural marshes in the great abundance of small and delicate plants which elsewhere appear to be only occasional in wet places. It differs also

in the large number of apparently very closely allied species in close contiguity. These are mostly members of the *Scrophulariaceæ*, *Cyperaceæ* (smaller species), *Utricularia* and *Eriocaulon*. Some of the *Utricularia* are slender climbers round the rice-halms and are leafless at the time of flowering. The floating *U. stellaris* with large vesicles is, however, a plant of the natural marshes, and I have not observed it in rice-fields. The species of *Eriocaulon* are more abundant after the water has subsided in the cold season, and with them appear several small *Compositæ* such as *Cotula*, *Sphæromorphæa*, *Centipeda* and *Grangea*, which are allied genera, and *Sphæranthus*, *Gnaphalium* and *Cæsulia*.

114. In dealing with the general flora of the open Gangetic Plain, which forms the bulk of the Northern tract, we have postponed consideration of the more natural Khair-sissu forests, the hills of Northern Champaran and the remnants of natural forest in Northern Purneah.

115. *Khair-Sissu.*—On the banks of the great rivers, like the Kosi and Gandak, many square miles of country are frequently inundated, old lands torn away and fresh deposits of gravel and silt formed. On these spring up a forest, the Khair-Sissu formation. The Sissu (*Dalbergia sissu*) and the Khair are not usually indiscriminately mixed, but each forms gregarious patches, no doubt due to the heavier seeds of the Khair being deposited where there is too much current for the lighter fruits of the Sissu (the seed germinates through the pericarp) to come to rest. Other very common accessory trees in these forests are the Simal (*Bombax*), *Odina wodier*, *Kydia calycina*, *Albizzia stipulata*, *A. procera*, sometimes *A. lucida*, the Hog plum (*Spondias mangifera*), Karam (*Adina*), *Stephegyne* (*Mitragyna*), *Mallotus philippinensis*, *Terminalia belerica*, *Eugenia* spp., Bael, *Trewia nudiflora*, *Streblus asper*, occasional Tun (*Cedrela toona*) in depressions, *Bridelia*, climbing acacias, and figs (especially *F. glomerata*).

116. *The Sameshwar Hills* (see p. 4) have a flora which is essentially lower Himalayan. A list of the more characteristic, arranged according to their habitat, is given on pp. 53, 54. Here it is only necessary to refer to such striking species as *Pinus longifolia*, *Cycas pectinata*, *Sterculia pallens*, *Grewia helicterifolia*, *Eriolæna Wallichii*, *Rhus semialata*, *Moringa oleifera*, *Butea minor*, *Osbeckia nepalensis*, *Piper peepuloides* and *Desmodium confertum*.

117. Other species now known to extend to the cooler parts of the Central and Southern tracts are also characteristic of the lower Himalaya, such as *Gnetum scandens*, *Uvaria Hamiltonii*, *Meliosma simplicifolia*, *Trevesia palmata*, and *Cyclostemon assamicus*.

118. On the other hand species more characteristic of the Central tract are here found in very small quantities, such as *Scleichera trijuga*, *Buchanania latifolia*, *Gardenia turgida*, *Bassia latifolia*.

119. The plants common to both the sub-Himalayas and to the Central and Southern tracts would form a very long list. It is only necessary to mention a few:—*Dillenia pentagyna* (more sub-Himalayan but found in valleys in other tracts), *Millusa velutina* (ditto), *Shorea robusta*, *Kydia calcyina*, *Thespesia lampas*, *Bombax malabaricum*,

Sterculia villosa, S. colorata, Helicteres isora, Grewia tiliæfolia, G. vestita and *G. elastica, G. disperma, G. hirsuta, Aegle marmelos* (dry exposures), *Bursera serrata, Amoora rohituka*, etc., etc. (a fuller list is given on p. 51).

120. The N.E. corner of Purneah used in Hamilton's time to be forest which formed part of " a large wooded tract that extends into the district of Tirahut." This corner, although not in the hills, is tropical Himalayan in character, and partakes of the nature of the Sikkim Tarai, though most of its natural jungle has now disappeared. The following trees are very distinctive:—*Alangium* (*Marlea*) *begoniæfolia, Grewia multiflora, Premna latifolia* var. *Gamblei* (Gineri), *Tephrosia candida, Vangueria spinosa, Natsiatum herpeticum, Aporosa, Phlogacanthus, Vitis adnata, Calamus guruba, Deeringia celosioides*, and many ferns growing in the open, *e. g. Anisogonium esculentum, Nephrodium molle, N. aridum*, etc., which in other districts are found under shade.

121. The grass lands of the Northern tract occupy a considerable area. The low-level grass lands pass into the swamps, and their grasses are usually large or gigantic perennials with annual flowering stems and rootstocks which frequently form tussocks. The lowland savannahs are natural grass lands which are water-logged for a part of the year, but they pass into evergreen forest where the water is flowing. The high level savannahs often are the result of old cultivation, maintained in the state of grass by firing and grazing. The principal grasses on the lowlands are, according to a note by me in 1896, in the adjacent tarai *Saccharum procerum* (called *S. arundinaceum* in the Flora), *S. spontaneum, Ophiurus megaphyllus, Arundinella brasiliensis, Phragmites karka, Triraphis madagascariensis*.* To these may be added the fragrant-rooted *Vetiviera*, which is sometimes very abundant, *Anthistira gigantea, Coix* and others, and the low land savannahs are further characterized by large *Scitamineæ*, species of *Alpinia, Hedychium, Costus*, etc., while in the adjacent Tarai the large orchid *Arundina* is conspicuous.

122. The grasses of the high-level savannahs are less large, but also usually perennial-rooted. The chief are *Saccharum narenga, S. fastigiatum, Cymbopogon nardus, Polytoca barbata*, and most of the grasses of the savannahs of the Central tract, but no list has been made on the ground.

Saccharum munja (*tanggha*) appears to be a grass of high-level savannahs in the northern more humid belt, though like many other plants it retreats to the neighbourhood of rivers in the Central tract. The woody stems are like those of some other large grasses used for the walls of huts. The sheaths are made into coarse ropes called *muj*. *S. munja, S. narenga, S. spontaneum* and large species of *Themeda* are sometimes all found in close association!

123. After burning the savannah tracts become pretty with numerous herbaceous perennials which spring up from their bulbous

* Mr. Hole, in a letter, informs me that he thinks there are two species included under this name in the *F.B.I.*, the one named being a N.W. India form and ours being *T. Reynandiana*. I have not gone into the question.

or rhizomatous stocks. Among these are *Careya herbacea* with red shoots and large white and pink flowers, *Olax nana, Grewia sapida, G. scabrophylla, Ochna pumila* with beautiful large yellow flowers, *Aneilema scapiflorum* with blue flowers, and species of *Pancratium* with pure white flowers. About this time also the *Imperata* flowers, with its white plumes, though most of the grasses flower in the cold season after completing their season's growth.

124. When the grass lands of the Northern tract are only subject to early annual fires and light grazing, the first trees to appear are *Eugenia obovata, Simal, Garuga pinnata* and the shrub *Glochidion multiloculare.* These are followed by *Stereospermum suaveolens, Emblica officinalis* and *Lagerstrœmia parviflora.* Most of these trees appear to be comparatively frost-hardy as well as to a certain extent fire-resisting.

125. The effect of heavy grazing is gradually to eliminate the strong perennial grasses and finally to replace them by dwarf species, especially those, like *Panicum* (*Paspalidium*) *flavidum, Urochloa reptans* and *Chrysopogon aciculatus,* with leaves appressed to the ground.

Flora of the Central Tract.

126. In contrast to the Northern tract, the Central tract still contains a considerable area of forest, or jungle-clad land, and (with the exception of the Sameshwar Hills and N. Purneah of the former), its flora is far more interesting. This is chiefly due to the rocky surface having presented difficulties to cultivation. Its beautiful hills have served as a refuge for less civilized non-Aryan tribes, which have found much of their sustenance in its jungle products.

127. The flora is essentially tropophilous, but with a tendency towards xerophilous structure in many of its species. The Sal itself, the most characteristic tree of the area, is somewhat xerophytic in structure. Its leaves are very nearly persistent, and they thus have to stand the hot dry winds of February and March, while the new ones appear in May, when the relative humidity of the air is very low. They are therefore markedly coriaceous,* and possess a polished surface which reflects the sun's rays. On the drier aspects and dry tops of hills the trees become low and gnarled with relatively massive stems and smaller leaves (the so-called hill-type Sal), but provided the drainage is sufficient, the Sal is found on fairly heavy, as well as light soils. It is not deciduous sufficiently long nor sufficiently xerophilous to grow on the driest aspects.

On hot dry aspects it is supplanted by other trees of the dry mixed type, such as *Anogeissus latifolia,* the hill form of *Odina wodier, Nyctanthes, Cleistanthus collinus* (of which a form also occurs in the valleys), *Boswellia serrata, Sterculia urens* and *Cochlospermum Gossypium.*

* The upper surface has a thick cuticle and large epidermal cells deeper than broad. Beneath this are 2–3 rows of palisade cells, but this thin-walled tissue is interrupted at frequent intervals by large thick-walled tissue opposite to the vascular bundles which have numerous bast fibres. A similar thick-walled tissue interrupts the spongy parenchyma, so that the leaves are rendered very firm.

128. A thin papery outer bark which appears quite white and easily allows the passage of light is, as I pointed out in my *Fl. Ch. Nag.*, very characteristic of many trees growing in dry exposed places. They are almost true xerophytes and possess a layer of chlorophyll under the outer bark, and can remain therefore without their leaves for extraordinarily long periods. Thus *Sterculia urens* is leafless from November to May or sometimes June, *Odina wodier* from Nov.–May, and *Cochlospermum Gossypium* for the same period; the last, however, soon protects the lower part of the trunk with a very thick corky bark. The cuticle covering the chlorophyll layer of some of the white-barked trees is shed at short intervals. In some cases it is so thin that the bark appears green instead of white, as in species of *Commiphora* or *Balsamodendron*, a dry climate or desert genus, and to a less extent, the new bark after peeling, of *Sterculia urens* and others is green.

129. *Gardenia latifolia* is what is called a "chasmophyte." Its minute seeds germinate in the crevices of bare rocks. The crevices become filled with the growing rootstock, which also forms a broad cushion over the top. The tree has a *white stem with chlorophyll* and large coriaceous deciduous leaves covered with a resinous varnish when young. *Gardenia gummifera*, which grows on clay and quartz stones (p. 14) often on the tops of ridges in open forest, has polished smaller coriaceous leaves, also varnished while young. Its buds are protected by a large drop of resin. It and *Gardenia turgida*, one form of which is covered with strong opposite and decussate spines, have also a white bark. The young plants of all forms of *G. turgida* are exceedingly spinous.

130. *Ficus infectoria*, *F. glabella* and *F. tomentosa* are all species of rocky places (though *F. infectoria* is also an epiphyte, like many other figs), and more or less xerophytic in structure. The leaves of *F. tomentosa* are covered with a dense felt of hairs. It may sometimes be seen on old buildings (*e. g.* the Palamau Fort).

131. Among true xerophytes the candelabra-like *Euphorbia nivulia* often attains 20 ft. on bare rocky ground, though the seedlings often germinate under shade and somewhat resemble *E. fusiformis* of the Sameshwar Hills, which is mostly found under shade. Like the trees mentioned above the branches and young stems have chlorophyll, but in this case there is no, or very little, thin white bark but a green epidermis. The old stems develop thick cork. The asclepiad *Sarcostemma* is another xerophyte and chasmophyte, with green stems and branches. It also has a milky juice, and the presence of a milky latex (as in the more or less xerophytic figs, fleshy *Euphorbias* and the Euphorbiacean genera *Excœcaria* and *Sapium*, many more or less fleshy *Apocynaceæ* and *Asclepiadaceæ*) suggests that in some families it may originally have been favoured by xerophytic conditions, although still present in allies which are no longer xerophytic. The *Euphorbias* and *Sarcostemmas* develop leaves in the rainy season, though these are sometimes much reduced and soon deciduous.

132. The Sal formations occupy the greater part of the forest area. Sal ascends to the tops of the highest hills where the soil is sufficient,

but occupies an intermediate position between the driest and wettest areas in respect of soil. But the type of Sal varies, and its associates change with the type. It is at its best in valleys with a deep loamy soil derived from rocks of the Dharwars. This is the Valley type of foresters.

133. It has been frequently stated that Sal is not found on trap or on laterite, and it is true that it is not found on the trap of western India, and it is absent from serpentine,* but it is found on trap in the Santal Parganas and grows well on laterite in Singbhum, and it once extended to the edge of the laterite into Midnapur, where the remnants of Sal coppice may still be seen. Although trap may be an unfavourable sub-soil for Sal, other reasons must also be looked for to account for its absence from Western India, as it is also absent on sandstones and other rocks in the western parts of the Central Provinces.

134. As in the Central Provinces it appears to avoid certain close-bedded quartzites,† though it will grow among quartzite boulders, and it is decidedly calciphobous. It also avoids the cotton soil.

135. As showing how dependent its occurrence is on the physical properties of the sub-soil and its permeability by the roots, it will grow well on one side of a ridge composed of hard ferruginous schists inclined at an angle, more or less parallel to one slope, but not or only badly on the other, and this is independent of the aspect. The slope on which it grows well has the edges of the schists exposed, the other slope is more or less parallel to the lamination, thus presenting a surface with few breaks. On such unfavourable slopes is poor dry mixed forest, with frequently an abundance of *Nyctanthes*.

136. In the valley type Sal will attain very large dimensions in the Central and Southern tracts. When I first knew Singbhum in 1903, sound trees of 100 ft. in height and over 12 ft. girth were frequent in the then inaccessible parts of the forest.

137. The Sal associates in the valley type are different both from those of the Northern tracts and from the Hill type. Here *Careya arborea* and *Dillenia pentagyna* are not common, and they cease a little way up the slopes. On the other hand, *Terminalia tomentosa* and *T. belerica*, *Scleichera trijuga* and *Pterocarpus marsupium* are frequent associates.

138. The associates in the hill type are *Gardenia* spp., especially on clay, *Dillenia aurea*, *Phœnix* (on very poor soils or in open forest), *Terminalia chebula* (most frequent on flat hill-tops), *Anogeissus latifolia* (for fuller lists see p. 61).

The Mixed Forests of the Central Tract.

139. Foresters usually distinguish between Sal forest and Mixed forest, but mixed forest means in this sense forest without, or at least with very little, Sal. The term is retained here in the same sense, but excluding the belts of evergreen forest which occur along many river

* It is absent at least from the only serpentine hill I know of, the Kita Buru in the Saitba forest, which is occupied chiefly by *Phœnix acaulis* and grass.

† See the Introduction to *List of Trees, etc., of the Southern Circle, Central Provinces* 1916.

valleys, and especially along ravines in the higher hills. We can distinguish in the mixed forests several subsidiary types:

140. *The Terminalia formation.*—Some valleys containing good soil, but apparently with too much sub-soil water for Sal, contain *Terminalia tomentosa* as the principal species. Here also occur *Terminalia belerica*, large *Bombax, Sterculia villosa.* The raising of the water level by railway embankments will sometimes kill out the Sal and convert a previous Sal forest into *Terminalia.*

141. *Mixed forest: Dry type.*—Very dry aspects do not as a rule grow Sal, but show a more xerophytic type, though not always of the same constitution. The components of these dry mixed forests agree in that many of the species have a white outer bark permitting of the passage of light (*vide* para. 128). Such trees are *Sterculia urens, Anogeissus latifolia.* Other species develop below a thick corky bark, such as *Erythrina suberosa, Cochlospermum Gossypium.*

The driest parts of the Central tract (see Chap. III) are parts of Shahabad, Palamau and Gaya.* Gaya is said to be the hottest district in the province, and this is perhaps related to the destruction of the forest on the hill ranges. Parts of these forests still contain small Sal trees, but for the most part a dry mixed type or scrub, *Capparis sepiaria, Balanites, Zizyphus,* etc.

142. The sandstones of Shahabad once grew the *Hardwickia* formation, now mostly scrub. This was apparently a purely edaphic formation, although *Hardwickia* grows on other soils also in the Central Provinces.

143. *Khair type.*—Soil is apparently partly accountable for the distribution of the Khair (*Acacia Catechu*). It is a more crooked tree than the sub-Himalayan Khair and is apparently var. *Catechu* proper. Its presence is not always due solely to the soil. In parts of Palamau there is little doubt that human agency (including in this category fires, grazing, etc.) has favoured the Khair, and where the forests are protected the Khair disappears. It will not reproduce itself under shade either by seed or coppice. With the Khair, which must therefore have originated on open land, is associated *Woodfordia* (a shrub of open land), *Gardenia turgida, Carissa paucinervia, Stereospermum suaveolens, Boswellia serrata, Lagerstrœmia parviflora, Emblica officinalis.* These are all frost-hardy species. There also occur Satin wood (*Chloroxylon*), *Adina cordifolia, Mitragyna, Bridelia retusa* and *Anogeissus latifolia, Garuga pinnata, Ehretia lævis, Odina wodier, and Grewia tiliæfolia. Pennisetum setosum* often occurs as an undergrowth.

144. *Evergreen forest.*—Along rivers and streams in deep valleys the outer curves usually have high banks with Sal or *Terminalia*, the inner side of the curve has low flat ground frequently growing forest of a more or less evergreen type. In the hills both sides of the more steeply graded streams are usually similar and evergreen. But neither the Central nor Southern tracts possess the more beautiful type of evergreen forest which occurs in the adjacent more humid

* Only extreme southern part of Gaya and southern Shahabad are in the Central tract.

Tarai and Duars, where the branches of the *Eugenia formosa, Dillenia indica*, species of *Elæocarpus* and numerous other hygrophytic trees are hung with epiphytes.

145. At the lower elevations the evergreen belts are mainly composed of trees with their trunks clothed low down with branches, *e. g. Diospyros embryopteris*, which is very beautiful with its new flush of crimson leaves against the deep green of the older leaves, *Garcinia Cowa* with large edible yellow fruits, *Eugenia jambolana*, *Saraca indica* (also with tassels of crimson new leaves), and *Amoora rohituka*. Trees with tall clean stems also occur as a second storey, such as *Michelia champaca*, Mango, *Albizzia procera* and *odoratissima* (which are both deciduous), and *Litsæa nitida*. At higher elevations we find *Ficus Roxburghii, Symplocos spicata* and others (for more complete lists, see pp. 55 and 60).

146. The grass lands of the Central tract, apart from those of the *pâts*, are not very extensive, and are usually quite fitted to grow forest, which is suppressed by cutting and burning. The predominant species and one of the worst pests when its barbed fruits are ripe is the Spear grass (*Heteropogon contortus*). The fruits ripen in the cold season but remain long attached to the spike by their twisted awns, the barbs becoming free and pointing in all directions. By May the ground is so closely covered with them that a sudden shower produces the effect of its being covered with writhing insects, due to the contortions of the hygroscopic awns, which gradually work the fruits into the soil. In rocky places the *Pennisetum pedicellatum*, with its handsome reddish spikes, is frequent in Palamau; and on very rocky hills, but chiefly in some shade, the *Chrysopogon lancearius* is characteristic. A valuable fodder grass, but not nearly so frequent as in the Central Provinces and occurring chiefly on cotton soil in the Southern tract is *Iseilema laxum*. It sometimes occurs mixed with Spear grass and species of *Themeda*.

Imperata is characteristic of clayey and lateritic soils in some places only. *Saccharum spontaneum* as usual occurs on open, often more or less water-bearing or water-logged lands. Other species of *Saccharum* are rare, but *S. munja* occurs along gravelly or sandy river beds, and *S. narenga* in the damper Sal forests, chiefly at high elevations. The grasses which occur in the forest under light shade are nearly all those which are found in the open, but the most important grass of the hills in the Central tract, and one naturally always found under partial shade (though it is cultivated in the open in the Rajmahal Hills, etc.), is the Sabai (*Puliculum angustifolium*, better known as *Ischæmum angustifolium*), so largely used for paper-making. It requires good drainage, but is often found on kunker or lime-impregnated soils. Species of *Pollinia* are very common in open Sal forests with clay soil. For other common grasses in the forest and a list of grasses on the pats see pp. 55, 57, 58, etc. Most of these latter are found, though less gregariously, in all parts of the Central and Southern tracts.

147. The *pâts* (p. 9) and higher mountains of the Central tract possess many elements of a more temperate flora which occur else-

where, either in the lower Himalaya or in the mountains of Madras, or both, and a few which are closely allied to plants in one or both of those regions, but appear endemic.

148. To this last category belong *Hypericum Gaitii* allied to *H. cernuum* (Himalayan) and to *H. mysorense* (Madras), and *Thesium unicaule* allied to *T. himalense* (Himalayan) and to *T. Wightianum* (Madras). *Jasminum strictum* is apparently related to *J. Wightii* of Madras. *Pimpinella bracteata* is allied to *P. diversifolia* (Himalayan), and apparently to *P. Candolleana* (Madras). *Ligusticum alboalatum* appears to have no Madras representative, and *Carum villosum* also appears to be endemic or undescribed, but its fruit is at present unknown.

149. The high mountains and páts of Chota Nagpur would appear to have served as stepping-stones for the passage of species from the highlands of the peninsula to the newer Himalaya, or in some cases in a reverse direction, and at one time their elevation and that of many intermediate now low ranges was no doubt very much greater * ; the high mountains of Meghasani and others in the Southern tract would similarly have served as stepping-stones.

150. A fuller list of the species of the *páts* is given on pp. 57, 58, from which the following are selected :

Pittosporum floribundum, distrib. Himalaya and Nilghiri. *Hypericum japonicum*, distrib. Garwhal, Himalaya to Burmah and hills of peninsula. *Geranium ocellatum*, distrib. Himalaya up to 6000 ft. *Viola Patrinii*, distrib. Himalaya and hills of peninsula (also in Cent. Prov.). *Rhamnus dahuricus*, distrib. Himalaya and western ghats. *Rubus molluccanus*, Himalaya and western ghats. *R. ellipticus* does not now occur in the Central tract, but it does on the higher mountains of the Southern tract. *Potentilla Kleiniana*, distrib. Himalaya and Nilghiri Mts. *P. Leschenaultiana*, distrib. Western Himalaya and Nilghiri Mts. *Rubia cordifolia*, distrib. Himalaya and most hilly districts of the peninsula up to 7000 ft. *Artemisia parviflora*, distrib. Himalaya, ascending to 11,000 ft. in Sikkim, also western ghats and hills of Burmah. *Conyza ambigua*, distrib. Himalaya and Nilghiri and Pulney Hills over 6000 ft. (Gamble). This is said to be an escape, but I doubt it. *Lobelia zeylanica :* ours is apparently a distinct variety, but the species is distributed in the Western Ghats and there is one record from Mysore. It is said to be common in Ceylon. *Geniosporum elongatum*, distrib. Jeypur Hills and Ceylon (this should be called *G. indicum*, Briq. according to Gamble). *Plectranthus ternifolius*, distrib. Himalaya to Assam. *Plectranthus menthoides*, distrib. Mahendragiri, Western Ghats, and if this be merely treated as a variety of *P. coetsa*, then also Himalayas. *Scutellaria discolor*, distrib. Himalaya to Assam and Burmah, also Bababudan Hills of Mysore (Gamble).

It will be observed that the Himalayan element is stronger and the Chittagong-Burmah element a good deal weaker than in the mountains

* Duncan and others also refer to evidences of an exceedingly cold if not glacial condition during part of the Gondwana period, but this would have been prior to the Angiospermous flora.

of the Southern tract. This may be partly due to climate, the cooler drier cold season and the hotter drier hot season as compared with the climate of the mountains of Orissa with their tempering sea-breezes.

151. The flora of Parasnath has been more carefully investigated than that of any other portion of our province. It was dealt with by Hooker in the Himalayan *Journals* and Dr. Thomson spent several days on the mountain. He also paid a second visit there in company with Dr. Anderson, and it has been further botanized by Edgeworth, Clarke and others.

Anderson, while officiating as Superintendent of the Calcutta Gardens, collected the investigations of himself, Hooker, Edgeworth and Thomson into a paper, published in the *Journal of the Asiatic Society of Bengal.* The only species found on Parasnath but which have not been recorded also from other parts of the province now are: *Berberis asiatica, Pygeum Andersoni* and *Kalanchoe heterophylla.* Of these the *Pygeum* is an exceedingly rare plant. I believe that the only other locality where it has been found is Mahendragiri Mountain in Ganjam, elev. 4500 ft.! The *Berberis* is Himalayan, but the Parasnath plant differs somewhat from the type. The *Kalanchoe* is frequent on mountains in the Dekkan. It is to be noted that, in addition to the above, Sir J. D. Hooker regarded the Parasnath palm *Phœnix robusta* as a distinct species, and Anderson in his paper mentions 2 species of *Araliaceæ* (undetermined), which I have not traced.

Flora of the Southern Tract.

152. It has been said that the topography of the Southern tract is much more varied than that of the Central or Northern tracts; the flora also shows much more variety. The climate, however, is more equable, frost never occurs, and the temperatures are higher with greater relative humidity, especially in the districts bordering on the coast. The area is also more tree-covered (*i. e.*, has been interfered with less by man). The Saranda forests of Singbhum with their high mountains and deep valleys with perennial streams are floristically a part of the Southern tract. The higher parts of Parasnath, although more humid than the rest of the Central tract, do not bear any great resemblance to the Southern tract in their flora (see para. 151).

153. The Sal formations in the Southern tract, where they occur, do not differ much from those already dealt with, but they tend to become more mixed with the species belonging to other types of forest. The Sal sometimes occupies the flatter ridges, while the steeper drier slopes are occupied by a mixed forest, and a more humid type of mixed forests or thorny bamboo occupies the valleys. In Kalahandi natural Teak occurs in the valleys mixed with the Sal. In other cases and more especially in Sambalpur in a less humid climate the base of the hills is occupied by Sal, the slopes by poorer Sal and mixed forest, and the tops especially on quartz and mica schists are monopolized by the male bamboo (*Dendrocalamus strictus*). This

last is apt to take possession entirely where coppice fellings are carried out without the bamboo itself being cut.

154. The better Sal forest which grows on loam in Angul above the level of competition with the thorny bamboo has as its chief associates *Terminalia tomentosa*, *Pterocarpus marsupium*, Mango, *Ougeinia dalbergioides*, *Anthocephalus cadamba*, *Bursera serrata*, *Miliusa velutina*, and also often large *Anogeissus latifolia*—a somewhat heterogeneous assemblage of trees of damper and drier conditions! On the quartz and mica schists which give a light-coloured soil, on which Sal is never seen well-grown, is *Gardenia gummifera* (especially characteristic of clays and quartz), *Chrysopogon monticola*, *Heteropogon contortus* and *Aristida*. In some parts of Sambalpur the Sal is much attacked by *Loranthus longiflorus*.

155. *The bamboo formations.*—In many of the valleys and eastern plains the Sal and *Terminalia* is ousted by the growth of bamboo. Especially gregarious is the thorny bamboo (*Bambusa arundinacea*), but in a few cases *Cephalostachyum pergracile* or *Oxytenanthera nigrociliata* is found. Few formations are more impenetrable than the thorny bamboo forests, or grow fewer subsidiary species. The few trees that occupy them are remnants of those that obtained a footing during one of the recurrent flowering periods, and of undergrowth there is none. It was however in streams flowing through thorny bamboo that I first came across the *Lawia zeylanica*.

156. *Dendrocalamus strictus* often occupies the hills (see above under Sal), as in some areas of the Central tract. It is rarely very well grown, but is apt to take possession of the ground where the rock is near the surface. It does not flower gregariously like the *Bambusa*, but some different clumps flower every year.

Mixed Forests of the Southern Tract.

157. *Humid mixed forests.*—The highest hills ascend to 4000 ft. and these possess a semi-evergreen type of forest (though Sal is common on the drier ridges) between 3000 and 4000 ft. The more interesting of the species are those which bring a strong Chittagong and Eastern Himalayan element into the flora. Among the former are *Machilus villosa*, *Vitex glabrata* (also Santal Parg.), *Alphonsea ventricosa*, *Turpinia pomifera*, *Eugenia fruticosa*, *Sapium insigne*. Among Himalayan species are *Euonymus glaber*, *Leea acuminata*, *Rubus ellipticus*, *Villebrunea frutescens*, *Pilea scripta*, *Baccaurea sapida*, while *Aralia armata*, *Hyptianthera stricta*, *Elæocarpus Wallichii*, *Clematis smilacifolia*, *Styrax serrulatum* extend to Burmah and *Phœbe lanceolata*, *Turpinia pomifera* are both of Chittagong and the Himalayas. The Chittagong element is especially interesting, inasmuch as it is found also at lower elevations and in the coastal districts (see pp. 48, 49).

Especially noteworthy is *Evodia meliæfolia*, from the mountain ravines of Bonai. This plant has only been previously found by me in the mountains of British Bhutan, and is only recorded in the *Flora of British India* from Assam.

158. *The drier mixed forests of the Southern tract* are usually

those on steep slopes below the ridges. Sal is usually absent, though many of its associates remain. *Bursera serrata* (which attains 6 ft. girth in the Raigarh forest), *Dalbergia latifolia* (only reaching large girth in the valleys), *Cleistanthus patulus* (especially in rocky ravines), *Callicarpa arborea*, *Grewia tiliæfolia* and *G. elastica*, *Hymenodictyon*, *Sterculia villosa* and *S. colorata*, *Anogeissus latifolia*, *Walsura piscidia*, *Ougenia dalbergioides*, *Bridelia retusa*, *Petalidium* are frequent. On rocks are *Hemionitis arifolia* and *Drynaria quercifolia*.

At lower elevations is much *Diospyros sylvatica*, *Melia composita*, *Gelonium*, *Capparis Roxburghii*, and *C. sepiaria*, but it is difficult to draw a line between this type and the evergreen forest on the one hand and the laterite or sandstone low mixed forest on the other.

159. *The Khurda laterite and Athgarh sandstone.*—A considerable area between the coast and the mountains is occupied by a low laterite plateau. It often overlies the Athgarh sandstones, and in some places laterite occurs on the sandstone, so that it is difficult without much study to separate the sandstone flora from the laterite. The list on p. 56 therefore merely records the species occurring in the mixed forests and scrub jungles of the lower elevations, whether on laterite or sandstone.

Among the most noteworthy trees are *Xylia* (dist. both peninsulas), *Zanthozylum budrunga* (also Chittagong), *Vitex pubescens* (also Chittagong), *Erioglossum edule* (dist. Oudh to Chittagong and Burma), *Lepisanthes tetraphyllus* (dist. both sides of the western peninsula and also to Burma), *Diospyros sylvatica* and *D. cordifolia*, *Soymida febrifuga*, *Chloroxylon swietenia*, *Eugenia bracteata* (dist. both sides of peninsula and Assam and probably Chittagong), and *Hugonia mystax*.

160. More especially on the laterite appears to be the very important tree *Strychnos nux-vomica*. *Strychnos potatorum* also occurs, but in a more evergreen type of forest, and on alluvium. It is also a more westerly species. More characteristic of laterite is *Webera corymbosa* and *Flacourtia sepiaria*. Especially characteristic of the sandstone is *Randia malabarica*, *Maba buxifolia*.

161. Much of this tract is still in the state of "*Induced Scrub*" in the eastern districts. This occurs on heavily grazed lands, both on laterite and the sandstone. But the previously scrubby reserves are slowly forming a more arboreous type and, comparing them with Gamble's description of them forty years ago,* the change may even be said to have been rapid. Excepting in the Mals of Orissa,† most of the forests are managed as coppice, and the undergrowth is so dense that the more arboreous species are handicapped in the struggle against the more shrubby and closely branched ones. The thorny species are chiefly *Flacourtia Ramontchi*, *sepiaria* and *cataphracta*, all of which also occur in Purneah; *Phyllochlamys spinosa* and *Plecospermum spinosum*, the former of which spreads to Burma and the Andamans and the latter is sub-Himalayan and Cingalese, while *Limonia acidissima*, also common, is a small tree of drier regions

* See Gamble, *Report on the Forests of Khoordah, Orissa*, April 27th, 1881.
† The Mals of Orissa is a hilly very feverish tract in the south bordering on the Madras Presidency. It contains much high forest.

and is frequent in the Central tract. *Atalantia*, species of *Carissa*, *Randia*, 2 spp., and other thorny or prickly trees or shrubs also occur. In these forests climbers are also excessively numerous, thus further handicapping the trees.

162. *Evergreen forest type.*—The evergreen type is far more extensive in the Southern tract than in the Central, as would be anticipated from the greater humidity, especially near the coast. The evergreen of the mountain tops has already been referred to; that of the low-lying regions contains a large number of species (see pp. 55, 56), of which the most interesting, perhaps, are *Garcinia Xanthochymus*, a tree of the eastern Himalaya, Chittagong, Burmah and the Bombay ghats, all regions of heavy rainfall; *Garcinia cowa* (also Chittagong); *Aporosa Roxburghii*, also in eastern sub-Himalaya, Chittagong and Burmah; *Macaranga peltata*, a rapidly growing tree overtopping the Teak in plantations (dist. Western Ghats); *Polyalthia simiarum*, distributed Chittagong, Burmah, Duars, a tall straight tree with pale bark and large leaves; *Canthium glabrum* also occurs in the high-level evergreen forest, distrib. Burmah, Duars and Malay Peninsula; *Diplospora singularis*, distrib. Khasia, Burmah and Ind. Archipel.; *Alphonsea lutea*, distrib. Silhet and Burma; *Unona discolor*, distrib. Duars, Silhet, Chittagong and Burma; *Amoora spectabilis*, distrib. Duars to Burma.

Coastal Tracts.

163. The low laterite or rocky promontories rarely quite reach the shore line, and between them and the shore are frequently cultivated alluvial plains which run inland a long way at the principal rivers. These alluvial plains are chiefly rice-fields, of which the general character is much the same as in the other tracts. In some places they give way to sandy waste dotted over with the palms *Phœnix sylvestris* and *Borassus flabelliformis* or, nearer the sea, *Cocos nucifera*, and along the coast a semi-naturalized growth of *Casuarina*, *Calophyllum*, Cashew nut, *Pandanus tectorius* and *Opuntia*. On the littoral sands these species also grow, and there is in addition a natural herbaceous open formation which becomes denser in the rainy season. Some of the plants of this formation are sand-binders. Among these may be mentioned the *Ipomœa pes-capræ*, the interesting suffruticose diœcious grass *Spinifex squarrosus*, of which the large globose female heads, driven by the wind, bound along on its elastic spinous bracts, and *Cyperus arenarius*. But there are no sand-binders of the efficiency of (for instance) the Marram grass of temperate dunes. The *Opuntia* forms one of the best sand barriers and wind breaks, and it continually rises on a bank formed by itself as the wind-blown sand drives through it and is deposited on the lee side. The sand flora requires further study. (See also p. 58.)

164. *The Mangrove formation.*—The tidal forests extend along the coast from the Baitarani River at Chandballi to the Tallanga Canal south of the Mahanadi, but saline marshes with some of the characteristic trees of the deltaic swamps, *e. g. Excoecaria agallocha*, *Acanthus ilicifolius*, are also found in Balasore at the mouth of the Burubulung

and at other places. The mouth of the Subarnareka I have not seen. The higher lands between the numerous creeks and channels are usually sandy open grassy areas as already mentioned, without forest, but grazing large herds of cattle and deer. They are fringed with trees and shrubs common in the more inland forests, such as *Randia malabarica, Carissa spinarum, Azima, Maba, Erioglossum edule, Litsæa sebifera, Crotalaria striata, Zizyphus œnoplia, Streblus, Eugenia bracteata, Cæsalpinia crista.* More characteristic are *Cæsalpinia nuga, Pongamia glabra, Hibiscus tiliaceus* and the introduced trees *Anacardium* (Bajan, Or.) and *Calophyllum.*

165. In the swamp itself is an evergreen forest which relatively to a more terrestrial flora is exposed to the same conditions all the year round, the principal difference being perhaps the less salinity of the water in the monsoon. On the mud in the shallower water the "hital" *Phœnix paludosa* is often gregarious over considerable areas and a large handsome fern (*Acrostichum aureum*). Furthest out in the deepest water is *Rhizophora mucronata* with much branched stilt-roots and in less deep water *R. candelaria.* Other common species are *Ceriops Roxburghiana, Kandelia Rheedii, Bruguiera conjugata* with its variety *eriopetala* and *B. caryophylloides, Sonneratia apetala, Lumnitzera,* the Sundri (*Heritiera minor*) and many other species (see p. 58), of which 18 species not before recorded from Bihar and Orissa occur in the Sunderbans and Chittagong* and one, *Bruguiera caryophylloides,* has not been reported from these districts.

166. Most of the species are distinctly xerophilous in structure and possess thick or coriaceous leaves, sometimes with a shining at other times with a glaucous perhaps waxy cuticle, the thick leaves with aqueous tissue within. Several species, of diverse families, have pneumatophores furnished with numerous stomata or lenticels which admit oxygen to the roots. These are sometimes called blind root-suckers but they never appear to develop as suckers; they appear to be modified root structures, and all transitions occur from ordinary roots with ridge-like continuous projections furnished with numerous lenticels (*Carapa*), through rounded projections or knees in *Bruguiera* to erect peg-like projections 6–18″ high above the surface, which are often a serious impediment to walking as in *Sonneratia apetala,* where the pneumatophores are conical with exfoliating bark (exfoliating bark also occurs in *Bruguiera caryophylloides* according to Schimper), and the more slender pneumatophores of *Avicennia officinalis* and *Ceriops Roxburghiana.* The function of pneumatophores (*f.* Schimper) is also carried on by the upper parts of the stilt roots in *Rhizophora.*

167. The germination of the seeds while still on the tree, or the phenomenon of vivipary, is well known in *Rhizophora,* where the hypocotyle often attains a foot in length before dropping, radicle downwards, into the mud. A similar vivipary is seen in several other species of the tidal swamps. In *Kandelia* the hypocotyle also attains a foot, in *Ceriops* and *Bruguiera* 4–6″ in length. In the latter

* I was only able to give three days to this tour, most of which was on board a steamer, and a more extended inspection would add a very large number of species to the list.

genus there may be 3–4 cotyledons. In *Avicennia* the comparatively short hypocotyle has upturned hairs which act as a barb, and a short hypocotyle is developed before the fruit falls in *Ægiceras*. This last also occurs on the muddy shores of the Chilka Lake.

168. Along the sea front of the Orissa coast and washed up by the sea may be picked up various fruits and seeds. These may either be local or due to the North-East Monsoon drift, a current which sweeps up from the Malay Archipelago, curves round the Bay of Bengal and down the eastern coast of the Indian peninsula and which would thus convey drift from the Malay peninsula, Burmah, Chittagong and the Sunderbans and in favourable conditions of the wind deposit these on the Orissa coast. Among these fruits and seeds I have found *Nipa fruticans*, which *may* occur in the Mahanadi delta though I did not observe it growing there ; *Heritiera minor*, which is known to grow in all the coastal regions but may have come from Orissa itself ; the round smooth fruits (deprived of the exocarp) of *Calophyllum*, portions of the pseudocarp of *Pandanus*; hard grey, smooth seeds of *Cæsalpinia crista*,* etc. Among them is also a pyramidal fruit (?) somewhat resembling that of a *Pandanus* in shape which has not been identified.

CONCLUDING REMARKS ON THE PLANT COMMUNITIES.

169. The types of forest usually recognized have been mentioned in the preceding pages, and it has been pointed out that extensive formations, like that of the Sal, really embrace a large number of minor plant associations. Such constitutionally robust species occur in different forms under comparatively diverse conditions, and in the majority of cases the presence of one species has no direct bearing on the other components of the association. As for example, *Strychnos* occurs with Sal not because Sal has any direct influence on the *Strychnos* but because the other factors of the locality suit it, or because it is not crowded out by other species more suited to the locality. Hence Sal may occur in many associations where *Strychnos* is not found, and *vice versâ Strychnos* may occur in associations (such as on the southern laterite) where Sal is not always found.

170. In the Ramnagar (or Sameshwar) Hills *Bauhinia purpurea* is found on ridges with Sal, in the Central tract only along valleys or on cool sides of hills rarely with Sal. *Clausena pentaphylla* is found under Sal in Champaran; in Singbhum its place is taken by *Clausena excavata*, a species which occurs on ridges in the humid climate of British Bhutan. Whereas the presence of trees depends on the climate, elevation and soil, the presence of many of the smaller plants depends not only on these factors but on the presence of the trees, and the absence of many species from the Northern tract which occur in the adjacent Tarai and Duars and also sometimes in the more humid parts of the Southern tract is due to the destruction of the forests by human agency. The different combinations of species into associations are thus almost endless according to slight varying factors of the localities, and in the following tables it has been considered better

* *Cæsalpinia nuga* with large brown ellipsoid and compressed seeds is commoner in the tidal forests.

to classify habitats rather than plant-associations arranged under the dominant species in the association. Even this must necessarily be incomplete without involving excessive space, and only the more striking or characteristic species of each habitat can be mentioned.

171. The primary classification of habitats might be into Forests and Grass lands as is adopted by Schimper; but the grass lands in our area being for the most part artificial the prevalence of grass is a secondary consideration. Natural grass lands are probably only those in low-lying localities of very restricted area known to foresters as frost-holes.

172. It has been stated above that one species has usually no direct bearing on the presence of another. The proposition requires qualification in two directions. Apart from obvious cases where there is a direct relation (such as parasite and host), it appears from the tables as a fairly general rule that closely allied species are not usually found together or in similar habitats. Not only this but the plants, and this does not appear from the tables, even when they are so found in similar habitats are not always found in the *same* habitat. Thus *Mucuna imbricata* and *Mucuna monosperma* are both found in the more humid districts (with rainfall over 60″) along streams in more or less evergreen forest. Yet I have never seen these two species together or in the same valley. Nor can I say in what their requirements differ except that *M. monosperma* is perhaps usually under denser shade than its congener, and is more restricted in distribution.

173. Marked exceptions occur to the rule that closely allied species are not usually found in the same habitat in association. These are perhaps where the species are somewhat recent or elementary. Cases occur especially in the flora of the rice-fields. Witness the many small species of *Utricularia* and the species of *Scrophulariaceæ* of the closely allied genera* *Vandellia*, *Bonnaya* and *Lindernia*.

174. In some cases the presumed origin of some families under certain climatal conditions is well illustrated, *e. g.* the *Umbelliferæ*, presumably originated in a temperate or cold climate, are mostly confined to the elevated pats and tops of mountains.

175. The following trees and shrubs (in continuation of the short list on p. 37)† are common to the Central tract and to the Sub-Himalayan tract: *Naravelia zeylanica*, *Dillenia aurea*, *Tinospora cordifolia*, *Capparis horrida*, *Flacourtia ramontchi*, *Cedrela toona*, *Olax scandens*, *Elæodendron glaucum*, *Celastrus paniculata*, *Zizyphus jujuba*, *Z. rugosa*, *Mangifera indica* (certainly wild in ravines of C.T. and S.T., also probably along water-courses in the N.T.), *Semecarpus anacardium*, *Odina wodier*, *Spondias*, *Atylosia crassa*, *Butea parviflora*, *Millettia auriculata*, *Dalbergia volubilis*, *D. latifolia*, *Ougeinia*, *Indigofera pulchella*, *Cassia fistula*, *Bauhinia malabarica*, *B. purpurea*, *B. Vahlii*, *Mezoneuron*, *Mimosa rubicaulis*, *Acacia catechu*, *A. concinna* (rare in C.T. and S.T.), *Albizzia stipulata*, *A. procera*, *A. lucida* (rare in C.T., not seen in S.T.), *Anogeissus latifolia* (only on dry ridges in N.T.), *Terminalia belerica*, *T. chebula*, *T. tomentosa*, *Combretum decandrum*, *C. nanum*, *Eugenia jambolana*, *E. Heyneana*, *E. operculata*, *Careya arborea* (only in valleys in the south), *Woodfordia floribunda*, *Lagerstræmia parviflora*, *Casearia graveolens*, *C. tomentosa*, *Heteropanax fragrans*, *Anthocephalus cadamba*, *Adina cordifolia*, *Mitragyna*, *Wendlandia tinctoria*, *Hymenodictyon excelsum*, *Gardenia turgida*, *Randia dumetorum*, *R. uliginosa*, *Pavetta indica*, *Coffea bengalensis* (only in cool

* The separation of these genera is artificial as I have shown in the Flora, p. 630.
† N.B.—The list is not a complete one.

valleys in the south), *Hamiltonia suaveolens*, *Ardisia solenacea*, *Sideroxylon tomentosum*, *Symplocos racemosa*, *Jasminum scandens*, *Nyctanthes*, *Alstonia scholaris*, *Holarrhena*, *Wrightia tomentosa*, *Calotropis gigantea*, *C. procera*, *Cordia myxa*, *Ehretia lævis*, *Oroxylum indicum*, *Stereospermum tetragonum*, *S. suaveolens*, *Dædalacanthus nervosus*, *Gmelina arborea*, *Clerodendron infortunatum*, *Caryopteris Wallichiana* (rare in the south), *Holmskioldia sanguinea*, *Piper longum*, *Litsaea polyantha*, *Phœbe lanceolata*, *Loranthus longiflorus*, *L. scurrula*, *Bischofia javanica*, *Bridelia retusa*, *B. stipularis*, *B. tomentosa* (rare in south), *Flueggea*, *Kirganelia reticulata*, *Emblica officinalis*, *Croton oblongifolius*, *Putranjiva Roxburghii*, *Antidesma diandrum*, *Trewia nudiflora*, *Mallotus philippinesis*, *Celtis tetrandra* (very rare in south), *Trema orientalis*, *T. politoria*, *Streblus asper*, *Ficus bengalensis*, *F. retusa*, *F. comosa*, *F. religiosa*, *F. infectoria*, *F. hispida*, *F. cunia*, *F. glomerata*, *Salix tetrasperma*, *Smilax macrophylla*, *Phœnix acaulis*.

176. ABSTRACT OF HABITATS OR PLANT COMMUNITIES.

I. REGIONS OF GREATEST AËRIAL HUMIDITY, RAINFALL OVER 60″.
- §Bettiah-Ramnagar Sandstones.
  - *a*. Elevation 2000–3000 ft. (p. 53).
  - *b*. Ravines in the higher hills (p. 53).
  - *c*. Slopes and ridges up to 2000 ft; Southern slopes (p. 54).
  - *d*. Other slopes (p. 54).
  - *e*. Lower valleys and river sides (p. 54).
- §§ Other extra-littoral tracts. Soil physiologically moist.
  - A. Lands mostly tree-covered. Forests.
    1. Northern Purneah, rainfall over 80″ (p. 54).
    2. Rainfall under 80″. Evergreen forest, usually along streams in the plains, valleys in the mountains or on mountains at elevations over 2500 ft. (p. 55).
       - *a*. Species common to all three tracts (p. 55).
       - *b*. Species of Northern tract only (p. 55).
       - *c*. Species of Northern and Central tract (p. 55).
       - *d*. Species common to the Northern and Southern tracts only (p. 55).
       - *e*. Species of the mountains of the Central tract only (p. 55).
       - *f*. Species confined to the Southern tract (p. 55).
    3. Mixed Forests of the lower elevations of the Southern tract (see also littoral scrub jungle) (p. 56).
    4. Riverain forest of the humid zone (p. 56).
  - B. Open lands with few or no trees.*
    1. Savannahs of the Northern Tract (p. 57).
       - *a*. Highland savannahs (p. 57).
       - *b*. Lowland savannahs (p. 57).
    2. Along the courses of rivers and streams (non-aquatics) (p. 57).
    3. The open areas of the Central tract over 2500 ft. (p. 57).
       - *a*. Grass lands proper (p. 57).
       - *b*. Along water courses (p. 58).
       - *c*. Sunny slopes (p. 58).
       - *d*. Rocky places (p. 58).
    4. Marshes (p. 58).
    5. Aquatics (see III, where all aquatics area dealt with together) (p. 65).
- §§§ Littoral tracts. Soil physiologically dry (mostly saline).
  - A. Tree covered.
    1. Deltaic swamp forest (p. 58).
    2. Littoral scrub jungle, rocky faces of Chilka Lake (see B*b*).
  - B. Open coast.
    - *a*. Sands (p. 58).
    - *b*. Rocky places near the sea (p. 59).
    - *c*. Saline marshes (p. 59).

II. REGIONS WITH A RAINFALL USUALLY UNDER 55″ PER ANNUM.
- A. Forests, or lands mostly tree-covered.
  1. Soil mostly moist (p. 59).
     - *a*. Plains and valleys, general (p. 59).
     - *b*. *Bambusa arundinacea* formation (p. 59).
     - *c*. Evergreen forest belts, streams along valleys, etc. (p. 60).

---

* Village lands are treated together under II.

i. General (p. 60).
ii. In muddy streams under dense shade (p. 60).
iii. Clinging to rocks in the forest streams (see also Aquatics) (p. 60).
iv. Rocky or gravelly beds of streams in the forest (p. 60).
v. In humus under shade (p. 60).
vi. Rocky ravines (p. 60).
vii. Well-drained sides of nalas (p. 60).
d. Cool sides of hills (p. 61).
2. Soil with the water table often above the surface at one season, very deep at another. Riverain Mixed Forest (p. 61).
3. Soil mostly dry except in the monsoon (p. 61).
a. Hill Mixed Forest of Central tract and Southern tract (p. 61).
i. General. Hill type Sal formation (p. 61).
ii. Hot slopes and rocky tops of hills, usually without Sal (p. 61).
iii. Among rocks in the hills, not necessarily at the top (p. 61).
iv. Sandstone hills (p. 62).
v. Trap hills (p. 62).
b. Cotton soil (p. 62).
c. Open forest (p. 62).
d. Scrub jungles (p. 63).
i. On mixed soils (p. 63).
ii. On laterite (p. 63).
e. Under the shade of trees near villages (p. 63).
B. Open lands.
1. Grass lands inside the forest (p. 63).
2. Waste ground and pastures (p. 63).
a. General (p. 63).
b. Weeds of the rainy season (p. 64).
c. Damp waste ground (p. 64).
d. Dry waste ground (p. 64).
e. Ruins and rubbish heaps (p. 64).
f. Feral and naturalized plants (p. 64).
3. Marshes, margins of tanks, etc. (p. 64).
4. Saline marshes (p. 64).
5. Along rivers (p. 64).
a. On the banks (p. 64).
b. In the dry beds (p. 64).
c. In the beds with the roots in the water (p. 65).
d. On or among the rocks of rocky beds (p. 65).
6. Village lands (p. 65).
a. Cultivated (p. 65).
i. Rice fields (p. 65).
ii. On the bunds between rice-fields (p. 65).
iii. High-level fields (p. 65).
† In Northern tract only (p. 65).
†† Central and Southern tracts (p. 65).
b. Uncultivated in hedges, on trellises, etc. (p. 65).
III. Aquatics.
a. General (p. 65).
b. Running water (p. 65).
i. In the forest (p. 65).
ii. In the open (p. 65).
c. Still water (p. 65).

I. Regions of greatest aërial humidity, rainfall over 60″:—

§ Bettiah-Ramnagar Sandstone hill tract :—

a. Elevation 2000–3000 ft. :—

Eriolæna Wallichii, Rhus semialata, Lespedeza macrostyla, Uraria pulchra, Rubus ellipticus (also S.T.), *Bohmeria rugulosa.*

b. Ravines in the higher hills :—

Cleidion javanicum, Cyclostemon assamicus (also S.T.), *Gymnosporia rufa, Sabia paniculata, Meliosma simplicifolia, Albizzia lucida, Trevesia palmata* (also S.T.), *Chonemorpha macrophylla, Phlogacanthus, Ficus glaberrima, Dendrocalamus Hamiltonii.*

c. Slopes and ridges up to 2000 ft. General aspect south :—

i. *Pinus longifolia.* This constitutes a distinct formation in one small relatively dry area (see "Forests of N. Champaran," *Ind. For.*, June, 1917). Associated with it are few Sal, *Grewia helicterifolia, Inula cappa, Pollinidium angustifolium.*

ii. The Sal forms more than one formation according to type, chiefly on the lower slopes and on the bhabar at the foot. It calls for no special remark except that the lower Sal has *Dillenia pentagyna,* the upper *D. aurea* as an associate, and the damper Sal contains much *Croton oblongifolius.*

iii. The following are subsidiary species on slopes and ridges in both formations, and also occur without the principal species :—

Polygala crotalarioides (shrubby form), ***Sterculia colorata, Clausena pentaphylla, Iphigenia indica.***

d. Other slopes. These are chiefly occupied by a mixed forest :—

i. *Terminalia tomentosa* sometimes forms a nearly pure formation in saddles mixed with *Adina cordifolia* and with an undergrowth of *Capillipedium assimilis.* This formation also occurs in valleys with much *Piper longum* on the damp ground.

ii. Interesting species of the mixed forests are in the higher parts :—

Rubia angustissima, Polygala crotalarioides (shrubby form), ***Leucas helicterifolia.***

On a white sandy loam are found—

Euphorbia fusiformis and ***Echinacanthus attenuatus, Tylophora rotundifolia.***

Rather damper parts contain—

Sterculia colorata, Pterospermum acerifolium, Clausena pentaphylla, Hippocratea arborea, Jasminum caudatum, Smilax lanceæfolia.

e. Lower valleys and river sides :—

Sterculia pallens, Ilex umbellulata, Moringa oleifera (river banks), ***Tephrosia candida, Desmodium confertum, Butea minor, Osbeckia nutans*** (along streams), ***Osbeckia nepalensis*** (open grassy jungles), ***Bassia butyracea, Geniosporum strobiliferum*** (open grassy jungles), ***Lettsomia Thomsoni, Perilla ocimoides, Piper longum, Piper peepuloides, Cymbopogon microtheca.***

The last occurs in savannahs which are in most respects similar to those of the other moist tracts.

§§ Other humid extra-littoral tracts. Soil physiologically moist (*cp.* §§§) :—

A. Forest lands or lands mostly tree-covered (*cp.* B, p. 57) :—

1. Northern Purneah, rainfall over 80″. Forest and sward mostly evergreen :—

Stephania hernandifolia (also Champaran), ***Saccopetalum longiflorum, Vitis adnata, V. bracteolata, Elæocarpus serratus, Mallotus denticulata, Pueraria phaseoloides, Tephrosia candida, Jussieua fissendocarpa, Alangium begoniifolium, Vangueria spinosa*** (as distinct from ***pubescens***), ***Hedyotis scandens, Premna barbata*** (as distinct from ***calycina***), ***Litsæa salicifolia, Polygonum chinense, Dracæna angustifolia.***

In this district, also, many plants, not enumerated, found in evergreen forest of other tracts, grow in the open.

2. Other evergreen forest, usually along streams in the plains, or valleys in the mountains, or on the mountains at elevations over 2500 ft. Rainfall under 80″.

a. Species common to all three tracts:—

Clematis nutans, Naravelia zeylanica, Dillenia pentagyna, Bridelia stipularis, Leea crispa, Vitis pedata, V. auriculata, Saraca indica, Melastoma malabathricum (usually in open in N.T.), *Bidens pilosa, Amoora rohituka, Heteropanax fragrans, Celtis tetrandra, Artocarpus lakoocha, Sideroxylon tomentosum, Setaria plicata, Capillipedium parviflora.*

b. Species of Northern tract only (also most of those enumerated under the Bettiah tract, lower valleys, §*e*) :—

Bassia butyracea, Stephania hernandifolia.

c. Species of Northern and Central tracts only :—

Vitis lanceolaria, Siphonodon celastrineus (rare, only in S.P., in C.T.), *Vigna pilosa, Desmodium gyroides, Jasminum pubescens, Hedychium coronarium* (along watercourses in the hills of the Central tract).

d. Species common to Northern and Southern tracts only (the Saranda forests are included in the S.T.) :—

Michelia champaca, Tiliacora (also northern S.P.), *Gelonium multiflorum* (also northern S.P.), *Bridelia tomentosa, Mallotus repandus, Aporosa dioica, Putranjiva, Natsiatum herpeticum, Flacourtia cataphracta, Mesua ferrea, Pterospermum suberifolium, Alphonsea ventricosa* (northern S.P.), *Phœbe lanceolata, Calamus* spp., *Meliosma simplicifolia, Calonyction bona-nox, Premna scandens* cum *coriacea* (considered as one), *Randia fasciculata, Desmodium triquetrum, Vitex glabrata* (Rajmahal hills, moister parts, considered in this respect as part of Northern tract).

e. Species peculiar to the Central tract, rarely also S.T. These are mostly plants of high mountains :—

Helinus lanceolatus (almost in open), *Pygeum acuminatum, P. Andersoni* (Par.), *Berberis asiatica* (Par.), *Pittosporum floribundum* (down to 2000 ft.), *Viola Patrinii, Drymaria cordata* (Par.), *Rhamnus dahuricus, Smithia cilliata* (Par.), *Tephrosia tinctoria* (on bauxite), *Desmodium parvifolium, Dumasia villosa, Rubus mollucanus, Geranium ocellatum, Kalanchoe heterophylla* (Par.), *Bupleurum* 2 spp., *Ophiorrhiza fasciculata, Anotis calycina* (Par.), *Knoxia brachycarpa, Rubia cordifolia, Laggera alata, Conyza ambigua* (sunny slopes), *Vernonia divergens, Rhynchoglossum, Didymocarpus, Didissandra, Vitex glabrata* (Rajmahal Hills), *Asparagus gracilis* (Neterhat only), *Chlorophytum tuberosum* (in thin forest or sometimes in the open, also in Sant. Parg.), *Habenaria Stocksii, H. goodyeroides* and *H. Lawii, Pogonia flabelliformis* (in humus in the shade of rocks).

f. Species only found in the Southern tract (including the Saranda forests). Many are also Himalayan :—

Uvaria lurida, Unona discolor, U. longiflora, Polyalthia simiarum, P. cerasioides, P. suberosa, Alphonsea lutea, Anamirta cocculus, Gelonium lanceolatum, Prosurus indicus, Glochidion zeylanicum, Tragia Gagei, Bridelia verrucosa, Macaranga peltata, Acronychia laurifolia, Paramignya Griffithii, Evodia meliæfolia (Bonai only), *Vitis assamica, Leea æquata, Harpullia imbricata, Erioglossum, Lepisanthes, Mucuna monosperma, M. imbricata, Desmodium viscidum, Atylosia cajanifolia, Diplospora singularis, Hyptianthera stricta, Lasianthus truncatus, Psychotria adenophylla, Ophiorrhiza Harrisiana, Symplocos spicata, Jasminum scandens, Linociera malabarica, Ligustrum, Alstonia venenata, Anodendron, Ipomœa sepiaria, Ecbolium Linneanum, Litsæa nitida, Piper attenuatum, P. trioicum, Ficus asperrima, F. scandens, Laportea crenulata* (also in the Tarai and Duars), *Scindapsus* (rare also in C.T.), *Dracæna terniflora, Dioscorea oppositifolia, Curcuma aromatica, Oxytenanthera,*

The following are always close to the streams :—

Uvaria Hamiltonii, Garcinia cowa (Hamilton also reports it from Monghyr), *Garcinia xanthochymus, Elæocarpus robustus, Lagerstrœmia flos reginæ, Citrus aurantium, Amoora spectabilis, Antidesma bunius, A. acuminatum.*

Along marshy streams :—

Clinogyne dichotoma, Phrynium spp., *Habenaria triflora.*

The following mostly over 3000 ft. :—

Clematis smilacifolia, Elæocarpus Wallichii (distrib. Burma), *Baccaurea sapida* (Tarai and Duars), *Citrus medica, Rhamnus nepalensis, Euonymus glaber, Tarpinia pomifera, Aralia armata* (distrib. Sikkim and Burma), *Psychotria denticulata, Chasalia curviflora, Styrax serrulatum* (distrib. Himalaya), *Peperomia reflexa* (also on Par. in C.T.), *Machilus villosa, Pilea scripta* (dist. Duars and Chittagong), *Villebrunea frutescens* (distrib. Himalaya), *Rhaphidophora, Sapium insigne, Leea acuminata* (also E. Himalayas), *Eugenia lanceæfolia* (dist. Duars), *E. fruticosa* (dist. Chittagong), *Rubus ellipticus, Ardisia depressa, Bridelia pubescens.*

The following mostly confined to rocky ravines :—

Dimorphocalyx glabellus, Lasiococca Comberi, Sansevieria Roxburghiana.

3. Mixed forests and scrub jungles of the lower elevations of the Southern tract. These are situated in the moister region and often not very far from the sea, but the soil is not saline. The scrub is an impoverished state of the Mixed, and there is no sharp line of demarcation. Several also occur in II (regions of lower humidity) :—

Pterospermum Heyneanum (extends to Sambalpur), *Xylia xylocarpa* (also Mayurbhanj, Narsingpur and Kalahandi), *Grewia rhamnifolia* (rocky forest), *G. aspera* (also C.T.), *G. multiflora* (also N.T.), *Cleistanthus collinus* (widespread), *C. patulus* (chiefly in rocky jungles), *Hugonia mystax, Ochna squarrosa, Zizyphus xylopyra, Allophylus serratus, Cylista scariosa, Tinospora cordifolia, Capparis floribunda, Putranjiva, Aspidopterys indica, Zanthoxylum budrunga, Toddalia aculeata, Acronychia laurifolia, Glycosmis arborea, Melia composita, Ougeinia, Pterocarpus* (both also C.T.),, *Ormocarpum sennoides, Capparis brevispina* (scrub), *C. Roxburghii* (rocky places), *C. sepiaria* (scrub), *Pavonia odorata, Hibiscus micranthus* (sandstones), *Grewia rotundifolia* (sandstones), *Webera corymbosa, Randia malabarica, Croton caudatus* (with Sal), *Mallotus repandus* (also N.T.), *Soymida* (esp. on *kunker*), *Erioglossum, Lepisanthes tetraphylla.*

In the moister mixed forests of Angul, Mango, *Anthocephalus cadamba, Alstonia scholaris, Bursera serrata, Miliusa* and *Melia composita* are usually prominent.

4. Riverain forest of the more humid regions. This includes and is chiefly confined to the Khair-Sissu Mixed forests of the extreme Northern tract. Besides the form of Khair (*Albizzia catechu* var. *catechuoides*) characteristic of it and the Sissu, which is scarce in our area as a wild tree, the following subsidiary species are characteristic :—

Erythrina indica, Adina cordifolia, Ehretia acuminata, Morus indica, Litsæa salicifolia (in the moister parts only), *Putranjiva* (ditto), *Tiliacora acuminata, Grewia multiflora* (in S.T. found in ever. for.), *Vitis angustifolia, Pæderia fœtida* (occasional also in C.T.), *Hedyotis scandens, Porana paniculata* (also in C.T. in hills and in Ramnagar Hills), *Premna latifolia* var. *Gamblei, Ipomœa vitifolia, Deeringia baccata* (with pretty scarlet berries), *Elæagnus latifolia.* Also very frequently *Albizzia stipulata, Cedrela toona, Trema orientalis, Streblus asper, Bridelia stipularis* with red drupes, *Ichnocarpus frutescens, Bryonia laciniosa, Hymenodictyon.* In more permanently moist depressions *Putranjiva, Calamus viminalis, Flacourtia cataphracta, Mallotus repandus, Litsæa salicifolia* and *polyantha, Alstonia scholaris, Randia uliginosa, Aporosa, Phlogacanthus thyrsiflorus* and *Entada scandens.*

B. Open lands with few or no trees :—

1. Savannahs of the Northern tract :—

a. Highland (*i. e.* not waterlogged or with moving water) savannahs. These are maintained in a state of grass by artificial means. They are caused by fresh deposits of silt or destruction of the forest :—

Grewia sclerophylla, *G. sapida* (also C.T. and S.T.), *Glochidion multiloculare* (and C.T.), *Ochna pumila*, *Olax nana*, *Leea crispa*, *Abrus pulchellus*, *Desmodium triquetrum* (and S.T.), *Flemingia involucrata* (and S.T. in low grass-lands), *Flemingia angustifolia*, *Careya herbacea*, *Oldenlandia gracilis* (all tracts), *Calotropis acia*, *Rivea ornata*, *Premna herbacea* (all tracts), *Clerodendron serratum* and *C. siphonanthus* (ditto), *Plectranthus ternifolius*, *Cyperus niveus*, *Saccharum fastigiatum*, *S. narenga*, *Puliculum articulata*, *Eulalia argentea*, *Andropogon apricus*, *Chrysopogon montanus*, *Amphilophis glabra*, *Cymbopogon nardus*, also many other Gramineæ. *Curcuma zedoaria*, *Pachystoma senile* (also C.T.), *Eulophia campestris* (also C.T.).

The first trees to obtain a footing in the savannahs are usually—

Eugenia operculata, *Garuga pinnata*, *Odina wodier*, *Phyllanthus emblica*, *Symplocos racemosa*.

b. Lowland Savannahs :—

Saccharum procerum, *S. spontaneum*, *Ophiurus megaphyllus*, *Arundinella brasiliensis*, *Phragmites karka*, *Triraphis* sp., *Anthistiria gigantea*, *Coix*, *Polytoca bracteata*, *Alpinia* spp., *Calamus guruba*, *C. tenuis*, *Ficus heterophylla*, *Rivea ornata*, *Hedychium coronarium* and *H. stenopetalum*.

c. The same, but grass kept short by heaving grazing :—

Zeuxine membranacea, *Z. affinis*.

2. Rivers and streams in the moist region (exc. the pats). Non-aquatics :—

a. Chiefly on the banks :—

Cochlearia flava, *Pulicaria foliolosa*, *P. crispa*, *Rosa involucrata* (also in C.T. and S.T., but usually in the forest where shaded), *Barringtonia acutangula* (ditto), *Cratæva religiosa*, *Saccharum munja*, *Campanula canescens* (also in C.T., but at high elevations), *Streptocaulon* (steep sandy banks in Purneah), *Hygrophila polysperma*, *Colocasia antiquorum* (var.), *Gleichenia linearis*.

b. Chiefly in the beds :—

Dentella repens (also rice-fields), *Tamarix ericoides* (also C.T.), *Cotula*, *Phragmites*, *Saccharum spontaneum*.

3. The "pats" and other grass areas of the Central tract over 2500 ft. The pats are usually grass lands. The condition is mostly due to the firing and grazing, aided by frequently unfavourable subsoil (trap or laterite) and strong winds which make re-afforestation difficult :—

a. Grass lands proper :—

Euphorbia prolifera, *Ochna pumila*, *Olax nana* (rare in II), *Hypericum japonicum*, *Geranium ocellatum*, *Viola Patrinii*, *Leea crispa*, *Erythrina resupinata*, *Indigofera Hamiltoni*, *Pycnocycla glauca*, *Peucedanum dhana* (*P. nagpurense* is a forest species at same and lower elevations), *Pimpinella monoica*, *P. bracteata*, *Combretum nanum* (also II), *Rhamnus dahuricus* (rocky places), *Rubia cordifolia*, *Conyza stricta*, *C. ægyptiaca*, *C. ambigua* (sunny slopes), *Pulicaria angustifolia*, *Glossogyne pinnatifida*, *Artemisia parviflora*, *Senecio nudicaulis*, *Tricholepis*, *Crepis acaulis*, *Sonchus arvensis*, *Lobelia zeylanica* (var.), *Jasminum strictum*, *Ipomœa barlerioides*, *I. petaloidea* var. *pauciflora*, *Geniosporum elongatum*, *Plectranthus ternifolius* (also N.T.), *Lavandula*, *Micromeria*, *Ajuga*, *Cyperus niveus*, *Curcuma angustifolia*, *Xyris coronata*, *X. pauciflora* (wet places), *Chlorophytum laxum* (dry places with rock near the surface).

The grasses themselves are not very characteristic :—

Andropogon apricus, A. assimilis, Axonopus semialatus, Arundinella setosa, A. Wallichii, Apluda varia, Arthraxon ciliaris, Anthistiria gigantea, A. imberbis, A. ciliata, Chrysopogon monticola, Cymbopogon Martini, Imperata, Ischæmum laxum, Saccharum spontaneum, S. narenga, Sorghum fulvum, Andropogon intermedius, Pollinia argentea, P. articulata (chiefly, like some of the others, in the neighbouring forest), and others.

b. Along the streams on the pats :—

Osbeckia chinensis and *rostrata* (wet places generally), *Osbeckia rostrata* var. *sexangularis, Hydrocotyle rotundifolia, Œnanthe stolonifera, Hypericum Gaitii, Desmodium parvifolium* (on banks), *Rubus mollucanus, Potentilla Kleiniana, P. Leschenaultii, Ligusticum alboalatum, Lobelia zeylanica* (var.), *Lysimachia obovata, Limnophila hypericifolia, Plectranthus menthoides, Dysophylla auricularia, Scutellaria discolor* (banks), *Polygonum pedunculare, Colocasia antiquorum* var. *stolonifera C. fallax, Thesium* (in wet grass), *Eriocaulon collinum* (semi-aquatic).

c. On sunny slopes :—

Elsholtzia incisa.

d. Among rocks :—

Dianella ensifolia (in the shade of rocks).

4. Marshes :—

Ranunculus sceleratus, Nasturtium palustre, Æschnomene aspera (jheels), *Stellaria Wallichiana* (under shade), *Fragaria indica* (damp shady places, hardly marshy), *Potentilla supina, Pentapetes phœnicea, Lippia geminata, Juncus bufonius, J. prismatocarpus* (wet ground rather than marshes and also in Central tract).

§§§ Littoral tracts. Soil physiologically dry (saline, or sandy and rocky, or both saline and sandy or rocky) :—

A. Forest :—

1. Deltaic swamp forest and saline marshes :—

Hibiscus tiliaceus, Thespesia populnea, Heritiera minor, Brownlowia lanceolata, Excæcaria, Carapa obovata, Dalbergia spinosa, D. candenatensis, Derris uliginosa Cæsalpinia nuga, Rhizophora 2 spp., *Ceriops, Kandelia, Bruguiera* 2 spp., *Lumnitzera, Sonneratia, Salvadora persica. Sarcolobus carinatus, Tylophora asthmatica, Pandanus tectorius, Phœnix paludosa, Ægialitis, Ægiceras majus, Parsonsia, Acanthus ilicifolius, Premna integrifolia, Clerodendron inerme, Avicennia, Flagellaria indica.*

2. Littoral scrub jungle. This is doubtfully classified as a physiologically dry soil. Its condition may be due to the poor soil (often laterite or sand) combined with strong sea winds. It passes into the Mixed forest :—

Gymnosporia emarginata, Scutia myrtina, Azima tetracantha, Pisonia aculeata, Weihea ceylanica.

B. Open coast (the sands in the rains are physiologically wet) :—

a. Sands :—

Phyllanthus rotundifolius, Euphorbia rosea, Agyneia bacciformis, Vitis vitiginea, Stylosanthes mucronata, Desmodium biarticulatum, Canavalia lineata, Osbeckia zeylanica var. *non-rostrata, Oldenlandia arenaria, Hydrophyllax maritima, Pedalium murex, Cyperus arenarius, Bulbostylis subspinescens, Spinifex, Allmania nodiflora* var. *Roxburghii, Crinum asiaticum* (also partially under shade of trees), *Crinum defixum* (but partly in water derived from streams), *Launea pinnatifida, Ipomæa pes-capræ, Pandanus tectorius, Calotropis gigantea.* While further from the sea occur *Casuarina, Streblus,* Cashew nut, *Calophyllum* and Palms. Excepting the Spinifex grasses are rare. *Panicum paspaloides* grows in semi-salt water. *Panicum repens* occurs on the sands but is common inland, and *Zoysia pungens* is rare.

b. Rocky places near the sea :—

Euphorbia caducifolia, Gymnosporia emarginata, Scutia myrtina, Vitis quadrangularis (also inland), *Ægiceras, Maba buxifolia* (also inland), *Azima tetracantha, Pisonia aculeata* (also inland).

c. Saline Marshes. This is mostly included under (A), as many of the species, like *Acanthus ilicifolius*, though preferring open marshes, are more or less shade-bearing and found in association with the trees in places with comparatively little water. *Salicornia brachiata, Suæda* 2 spp.

II. Regions of less aërial humidity, rainfall under 55″ per annum :—

A. Forest lands or lands mostly tree-covered :—

1. Soil mostly moist :—

a. Plains and valleys, general :—

The principal species are Sal, *Terminalia tomentosa* (all positions, but attains its finest dimensions in low moist valleys, where it sometimes is nearly pure).

Other characteristic species are :—

Polyalthia cerasioides (moister valleys), *Miliusa velutina, Hibiscus cancellatus, H. solandra* (C.T. only), *Thespesia lampas, Kydia calycina, Helicteres, Grewia tiliæfolia, G. Rothii, Bridelia retusa, Antidesma diandrum, Croton oblongifolius* (local), *Mallotus philippinensis, Phyllanthus debilis, Emblica officinalis, Garuga pinnata, Clausena excavata, Semecarpus anacardium, Vitis repanda, V. tomentosa, Leea aspera, Odina wodier* (moist type), *Ougeinia dalbergioides, Desmodium pulchellum, Millettia auriculata, Butea parviflora, Indigofera pulchella, Desmodium gyrans* (damp banks in r.s.), *Cassia fistula, Flemingia chappar, F. semialata* (moister places), *Terminalia belerica, Careya arborea, Lagerstrœmia parviflora, Mitragyna parvifolia, Adina cordifolia, Randia dumetorum, Wendlandia tinctoria, Siegesbeckia orientalis, Symplocos racemosa, Lettsomia setosa, Ficus comosa, F. infectoria, F. Rumphii, F. religiosa, F. bengalensis.*

Of the few *Cyperaceæ* which grow in the shade and away from water may be mentioned the species of *Scleria* and *Carex cruciata*.

Shade-bearing *Gramineæ* in the valley forests are the bamboo *Cephalostachyum pergracile*, found rather in deep ravines than in normal valley forest, *Chloris incompleta, Setaria plicata* (chiefly in I), *Panicum montanum* (but usually in the hill forests), *Arthraxon ciliaris*, and especially *Oplismenus compositus* and *O. Burmanni* which often grow under dense shade (see also grasses of ravines and evergreen forest). Open grassy forests are not included here.

The following appear only in the r.s. or end of the h.s. :—

Amorphophallus bulbifer, Arisæma tortuosum, Smilax macrophylla, Asparagus racemosus, Chlorophytum arundinaceum (also in the most humid tracts), more in the forest than the other species, *Crinum latifolium* (usually on the dry banks of nalas under shade), *Tacca pinnatifida* (in rocky ground), *Dioscorea anguina, D. belophylla* (chiefly rocky forest), *D. Wallichii, D. bulbifera, D pentaphylla.* Species of *Globba, Curcuma, Zingiber* and *Costus.*

Along streams under light shade :—

Amomum dealbatum, Habenaria platyphylla (on clay), *H. plantaginea.*

Under dense shade :—

Habenaria furcifera.

b. Bambusa arundinacea. This forms a pure formation in valleys in Angul or only fringing streams in the Central tract, where it

takes the place of the more usual evergreen forest. When once well established it kills out all competitors until it flowers.

c. Evergreen forest. This includes also those species which, not evergreen themselves, are only found along streams in the less humid tracts. The type passes into that of the moist regions (p. 55) :—

i. General :—

Michelia champaca (perhaps always with rainfall over 60"), *Dillenia pentagyna, Clematis gouriana, Polygala glomerata, Hibiscus pungens, Sterculia villosa, Triumfetta pilosa, Grewia disperma, Glochidion lanceolarium, Antidesma acuminatum, Bridelia stipularis, Cleistanthus collinus* (valley form), *Bischofia javanica, Heynea trijuga, Cedrela toona, Amoora rohituka. Saraca indica, Zizyphus rugosa, Gouania leptostachya, Vitis latifolia, V. auriculata, V. repanda, Hiptage madablota, Micromelum pubescens, Xylosma longifolia, Mangifera indica, Cratæva religiosa, Leea robusta, L. sambucina, Pongamia glabra, Saraca indica, Albizzia stipulata, A. procera, A. odoratissima, Desmodium polycarpum* (spreading generally into the valley forests), *Flemingia stricta* (ditto), *Mezoneurum, Entada scandens, Mucuna imbricata* (perhaps always in I), *Barringtonia acutangula* (on edges of rivers and along nalas), *Anogeissus acuminata, Terminalia arjuna* (rarely in the evergreen forest), *Combretum decandrum, Vangueria pubescens, Hedyotis vestita, Ardisia solenacea, Sideroxylon tomentosum, Erycibe paniculata, Diospyros embryopteris, D. sylvatica* (chiefly in I), *Jasminum pubescens* (S.P. only perhaps in I), *Linociera intermedia, Alstonia scholaris, Wrightia tomentosa, Strophanthus Wallichii, Strobilanthes scaber, Dædalacanthus nervosus, Vitex glabrata* (only S.P.), *V. peduncularis, Premna calcyina, Clerodendron infortunatum, Ipomœa turpethum, I. cymosa, I. vitifolia, Hewittia bicolor, Limnophila Roxburghii, Nelsonia campestris* (rarely in the open), *Oroxylum indicum* (in the open in I), *Bohmeria platyphylla, Scindapsus officinalis, Actinodaphne angustifolia, Beilschmiedia Roxburghiana, Trema orientalis* (in openings only), *Ficus comosa, F. hispida, F. scandens, Cyanotis tuberosa, Dioscorea dæmona* (also outside evergreen belts).

ii. In muddy streams under shade :—

Alocasia fornicata, Licuala peltata, Carex phacota, Curculigo recurvata, Musa ornata, Gastrochilus longiflora.

iii. Clinging to rocks in the streams :—

Lawia zeylanica (Angul, rainfall probably over 60"), *Cyathocline lyrata, Ischæmum hirtum, Vitis trifolia.*

iv. Rocky or gravelly beds of streams under shade :—

Ficus lanceolata, Lepidagathis fasciculata, Goodyera procera.

v. In humus under shade :—

Æginetia, Balanophora (on roots of trees).

vi. Rocky ravines :—

Vitis trifolia, Musa sapientum, Melothria heterophylla, Hiptage madablota, Murraya exotica, Tinospora malabarica (S.P. only), *Hibiscus tetraphyllus* (S.P. only), *Buettneria herbacea, Bridelia montana, Euphorbia nivulia, Ochna squarrosa* (also ordinary valleys in S.T.), *Pueraria tuberosa, Hymenodictyon, Hamiltonia, Millettia racemosa, Memecylon, Dimorphocalyx* (S.T. only), *Lasiococca Comberi* (S.T. only), *Combretum ovalifolium, Jasminum sambac* (S.T.), *Alstonia venenatus* (S.T. only), *Vallaris* (also N.T.), *Aganosma caryophyllata, Lepidagathis hyalina* and *fasciculata* (rocks and grass near rocky streams), *Holmskioldia sanguinea, Colebrookia* (also N.T. in open), *Pogonatherum saccharoideum, Arthraxon microphyllus, Capillipedium assimilis, Paspalum scrobiculatum, Thysanolæna agrostis, Caryota urens* (in C.T., in ordinary valley forest in S.T.).

vii. Well-drained sides of nalas, usually outside the evergreen belt :—

Combretum decandrum, Alangium Lamarckii, and several of those species which spread from the rocky ravines or the evergreen forest.

d. Cool sides of hills (usually north aspects) where the ground is more damp and rocky. This locality passes into the last, but it is situated further from the bottom of the valley :—

Hamiltonia suaveolens (also Champaran. In S.P. it occurs on trap, in Singbhum on quartzite, common in Monghyr Hills, and is generally local), *Bursera serrata*, *Hyptianthera stricta* (also on cool ridges in moist zone), *Blumea virens*, *Sterculia colorata*, *Chloroxylon swietenia*, *Gardenia latifolia*, *Thalictrum*, *Homalium nepalense* (also on ridges in moist zone), *Kydia calycina*, *Ochna squarrosa*, *Pterocarpus marsupium*, *Heteropanax fragrans*, *Scleichera trijuga*, *Cleistanthus patulus* (S.T. only), *Siegesbeckia*, *Crepis japonica*, *Mæsa indica* (and valleys), *Nyctanthes*, *Hemidesmus* (and ev. for.), *Canscora decussata* (esp. on damp. clay), *Oroxylum indicum* (and in valleys), *Radermachera xylocarpum* (and valleys) (S.T. only), *Callicarpa arborea* (and cool tops of hills), *Vitex peduncularis*, *V. glabrata* (only in S.P. and Mayurbhanj, mostly in moist zone), *Canscora diffusa* (damp banks and wet rocks, also in valleys), *Ficus glabella*, *Ficus cunia*, *Remusatia vivipara* (among rocks in very damp places), *Colocasia antiquorum* var. *rupicola*.

2. Soil with very variable moisture content at different seasons and usually free water in the dry season deep down. Riverain Mixed Forest. This is not well marked as a type away from the sub-Himalayan tract (see I), but the following often compose a narrow belt near rivers.

Terminalia arjuna, *Albizzia procera* (but chiefly in valleys), *Homonoia*, *Kirganelia*, *Trewia*, *Spondias*, *Crotalaria sericea*, *Phyllanthus Lawii* (see open river beds), *Celastrus paniculatus*, *Pongamia*, *Ehretia lævis*, *Ipomœa vitifolia*, *Vitex leucoxylon*, *Holoptelea integrifolia*, *Saccharum spontaneum*.

3. Soil dry except in the rainy season :—

a. Hill mixed forest of Central tract and Southern tract :—

i. General :—

Sal, hill type, *Garuga pinnata*, *Flacourtia ramontchi* (also valleys, and N.T. in scrub), *Olax scandens*, *Crotalaria albida*, *Buchanania latifolia*, *Odina wodier* (hill type), *Indigofera pulchella*, *Butea scandens*, *Erythrina suberosa*, *Ougeinia dalbergioides* (hill form), *Cassia fistula* (general), *Clematis nutans*, *Dillenia aurea*, *Saccopetalum tomentosum*, *Cochlospermum*, *Sterculia urens*, *Cleistanthus collinus*, *Ægle marmelos*, *Eriolæna Hookeriana*, *Grewia Rothii*, *Zizyphus xylopyra*, *Boswellia serrata*, *Chloroxylon swietenia*, *Elæodendron*, *Semecarpus anacardium*, *Odina wodier*, *Buchanania latifolia* (rare N.T.), *Gardenia turgida*, *Schleichera trijuga*, *Grewia elastica*, *Bassia latifolia*, *Gardenia gummifera* (chiefly on clay with quartz stones), *Schrebera swietenioides*, *Thunbergia fragrans*, *Ruellia suffruticosa* (mostly on clay), *Dædalacanthus purpurascens*, *Barleria cristata*, *Gmelina arborea*, *Wrightia tinctoria*, *Blepharis*, *Symphorema involucrata*, *Ficus Rumphii*, *F. infectoria* (also valleys), *F. bengalensis* (also valleys), *Pollinidium angustifolium* (Sabai grass, mostly on clay and lime soils), *Arundinella setosa*, *Pancratium triflorum*, *Smilax prolifera* (especially near dry ravines), *Asparagus racemosus*, *Urginea indica* (esp. on fire lines), *Curculigo orchioides*.

ii. Hot slopes without Sal and tops (usually rocky) of hills :—

Anogeissus latifolia, *Sterculia urens*, *Boswellia serrata*, *Bridelia Hamiltonii* (rare, chiefly on quartzite in S.T.), *Cochlospermum*, *Marsdenia tenacissima*, *Commiphora Roxburghii*.

iii. Rocky places in the hills :—

Polycarpæa corymbosa, *Bridelia montana* (rare, chiefly on quartzite, S.T., also Monghyr), *Waltheria indica*, *Boswellia*, *Marsdenia tenacissima*, *Hemigraphis latebrosa*, *Leucas montana*, *Glossocardia*, *Nyctanthes*, *Petalidium*, *Justicia betonica*, *Rhinacanthus communis*, *Dicliptera Roxburghiana* and *bupleuroides*, *Sarcostemma* (on the rocks themselves), *Boucerosia* (ditto, only in S.T.), *Pupalia lappacea*, *Ærua scandens*, *Allmania nodiflora*, *Ficus Arnottiana*, *F. tomentosa* (often on the rocks on the tops of the hills), *Arundinella setosa*, *Sorghum nitidum*, *Chrysopogon lancearius*, *C. montanus*, *Cymbopogon Martini*, *Pollinidium angustifolium*.

Dendrocalamus strictus usually forms a pure formation; the ground is not necessarily rocky, but the rock is usually close to the surface. In the *Dendrocalamus* formation is found *Lysimachia peduncularis.*

iv. Sandstone hills of C.T. :—

Hardwickia binata, Grewia hirsuta var. *helicterifolia.*

v. Trap hills:—

Neuracanthus tetragonostachyus.

b. Cotton soil or Regur :—

Feronia elephantum, Soymida febrifuga (also with kunker), *Zizyphus nummularia, Balanites Roxburghii, Dodonæa viscosa* (also on lime soils), *Butea frondosa, Dichrostachys cinerea,* Acacia tomentosa,* A. leucophlœa** (only reproduces in open forest), *Parkinsonia aculeata* (introduced), *Stephegyne parvifolia, Randia uliginosa* and the grasses *Ischæmum laxum, Themeda ciliata** and *T. quadrivalvis, Iseilema laxum,* Ophiurus corymbosus, Polytoca barbata.*

Very frequent, but less characteristic are—

Terminalia tomentosa, Gardenia lucida, Wendlandia exserta, Nyctanthes and *Chrysopogon monticola.*

c. Open usually grassy forest (the grassy tracts at high elevations mostly come under I) :—

Grewia hirsuta, Vitis latifolia (also in close forest), *Butea frondosa, Eugenia operculata, Wendlandia exserta* (usually in second growth), *Gardenia turgida, Elephantopus scaber* (also pastures), *Blumea flava* (mostly on clay soils), *Cassia tora, Knoxia corymbosa* (also in open), *Triumfetta rhomboidea* (also waste ground), *Cocculus hirsutus, Celastrus paniculata, Acacia lenticularis, A. catechu, Pæderia fœtida, Spermacoce stricta, Vernonia Roxburghii* (on trap in S.P.), *Antidesma ghæsembilla.*

In open forest with clay soil and not much grass the following are more usually found :—

Polygala leptalea, Ægle marmelos, Desmodium brachystachyum, Atylosia scarabæoides, Woodfordia floribunda (it usually germinates on bare soil, and is hence found in second-growth forest, which may ultimately become grassy), *Hedyotis hispida* and *pinifolia* (on clay), *Vernonia teres* (on clay), *Vicoa indica* (clay), *Blumea glomerata* (esp. on fire lines), *B. flava, Habenaria Susannæ* (in the monsoon), and some other species of *Habenaria.*

Open forest (continued). Not necessarily either grassy or on clay:—

Symplocos racemosa, Holarrhena (prefers well-drained damp localities), *Buddleia asiatica* (near open nalas), *Ehretia buxifolia* (rare), *Barleria prionitis* (usually on river banks), *Lepidagathis Hamiltoniana* (and waste ground), *Premna latifolia, Buchnera, Andrographis* spp., *Premna herbacea, Pupalia atropurpurea* (also waste ground), *Ærua monsoniana* (open Sal forest), *Achyranthes aspera* var. *porphyristachya, Aristolochia indica, Ficus parasitica, Plesmonium margaritiferum, Phœnix acaulis, Dioscorea Hamiltonii* (local, often along nalas but sometimes tops of high hills).

Chiefly grass glades :—

Rauwolfia serpentina, Swertia, Lettsomia bella, Ipomœa hispida, Hypoxis aurea, Tacca pinnatifida (often among rocks), *Dioscorea glabra* (esp. near nalas).

The grasses are mostly—

Eulalia argentea (clay soils), *Puliculum articulata, Sehima nervosum, Amphilopsis glabra, Heteropogon contortus, Andropogon apricus, Apluda varia.*

---

* These are the most characteristic.

d. Scrub jungles and Induced Scrub:—

i. General. This type extends into the more humid zone (see p. 56) and is not always separable*:—

Woodfordia, Cæsalpinia, Capparis sepiaria, C. horrida (but rather moister localities), *Flacourtia sepiaria, F. Ramontchi, Balanites* (esp. on cotton soil and along Sone valley on sand), *Limonia acidissima, Ægle, Zizyphus jujuba*, var. *fruticosa, Carissa paucinervia, Ipomœa quinata, Ichnocarpus frutescens, Cryptolepis Buchanani, Cassytha, Schizachyrium, Gloriosa superba* (and in hedges). On kunker—*Dodonæa viscosa, Mimusops hexandra*.

ii. Laterite scrub of the Southern tract. Where protected this is passing into Mixed forest:—

Capparis floribunda, C. brevispina, C. Roxburghii (rocky jungles) and *C. sepiaria*, but rarely in association, *Atalantia monophylla, Limonia acidissima, Ægle marmelos Toddalia aculeata, Glycosmis arborea* (but especially on sandstone), *Gymnosporia emarginata, Vitis repens, Webera corymbosa. Randia malabarica, Eugenia bracteata, Canthium parviflorum, Maba buxifolia, Diospyros sylvatica* (scrub form), *Hugonia mystax, Carissa spinarum, Ipomœa quinata*.

e. Under shade of trees usually near villages:—

Vernonia anthelmintica, Laggera pterodonta.

B. Open lands:—

1. Extensive grass lands in the forests (see also thin forest and glades and waste lands; many spp. are common to all three):—

Sida spp., *Urena* spp., *Sesbania aculeata* (wet ground), *Æschynomene indica* (ditto), *Osbeckia chinensis, Melastoma malabathricum* (in N.T.; in C.T. etc. it requires shade), *Leea aspera, L. crispa* (only in damper, cooler parts), *Grewia sapida, Indigofera* spp., *Glochidion multiloculare, Combretum nanum, Ochna pumila, Striga lutea* (wet places in grass), *Premna herbacea, Dysophylla* spp. (wet places in grass), *Clerodendron serratum* and *siphonanthus, Exacum tetragonum* (wet grass), *Cyperus niveus*.

The grasses themselves are very various, the most gregarious being:—

Heteropogon contortus and *Themeda* spp., *Polytoca barbata, Coix*.

In wet grass lands esp.:—

Rottbœllia exaltata, Mnesithea perforata, Hemarthria compressa, H. protensa.

Showing especially after the grass fires:—

Aneilema scapiflorum, Scilla indica, Chlorophytum spp.

2. Waste ground and pastures:—

a. General:—

Triumfetta rhomboidea, Sida spp., *Urena lobata, Euphorbia hirta, E. hypericifolia, Chrozophora Rottleri, Phyllanthus niruri, Zizyphus jujuba, Vernonia cinerea, Elephantopus scaber, Knoxia corymbosa, Crotalaria striata, Blumea lacera, B. laciniata Mollugo stricta, Ageratum conyzoides, Eclipta alba, Blainvillea, Trichodesma, Striga euphrasioides, Leucas* spp., *Calotropis gigantea, C. procera, Cynoglossum* spp., *Solanum indicum, S. torvum* (moister regions), *Vitex negundo, Anisomeles indica, Ærua lanata, Achyranthes aspera, Polygonum plebejum, Cyperus rotundus, Mariscus sieberianus, Eragrostis* spp., *Desmostachya, Urochloa repens*, etc.

The following especially in close-grazed grass:—

Ionidium, Tribulus (sandy ground), *Crotalaria acicularis, Desmodium triflorum, Zornia, Spermacoce* spp., *Chrysanthellum, Blumea oxyodonta, Heliotropium strigosum, Rungia parviflora, Eragrostis viscosa, Aristida setacea* (esp. on gravel); *Perotis latifolia, Chrysopogon acicularis* (esp. on damp ground).

---

* The rainfall varies from 51 to 65″ in the Southern tract on the east, where the scrub principally occurs. See para. 133.

b. Many are weeds only conspicuous in the rainy season, though some continue to flower and fruit into the cold season, *e.g.* :—

Cleome, Gynandropsis, Portulaca, Trianthema, Melochia corchorifolia, Corchorus spp., *Phyllanthus urinaria, P. simplex, Cassia occidentalis, C. tora, Bœrhaavia diffusa, Amarantus spinosus, Digera, Ipomœa pes-tigridis.*

c. The following especially occur on damp ground and several of the preceding may be found on damp ground in the h.s. :—

Sida acuta, Triumfetta annua, Mollugo spergula (sandy ground), *Blumea Hamiltoni, Xanthium strumarium* (esp. near river banks), *Centipeda, Launea nudicaulis, Centunculus tenellus* (damp banks), *Exacum petiolare, Ipomœa chryseides, Mazus, Adenosma, Lippia nodiflora, Clerodendron siphonanthus, Nepeta hindostana, Alternanthera sessilis, Commelina nudiflora, C. salicifolia, C. benghalensis, Aneilema vaginatum, Burmannia cœlestis, Zeuxine sulcata, Eragrostis, amabilis, E. gangetica, Isachne australis, Echinochloa colona, E. crus-galli, Paspalum flavidum, P. punctatum, Saccharum spontaneum, Imperata, Vetiviera, Eulalia Cumingii, Iseilema Wightii, Manisuris, Ophiurus corymbosus, Cynodon dactylon* (on sand).

d. The following chiefly on dry ground :—

Cocculus hirsutus, Triumfetta rotundifolia, Sida spinosa, Waltheria indica, Eleiotis sororia (sandy ground), *Echinops, Coldenia, Cucumis, Coldenia, Heliotropium indicum, Evolvulus alsinoides, Solanum xanthocarpum, Lepidagathis Hamiltoniana, Plumbago zeylanica* (among rocks), *Anisochilus carnosus* (ditto), *Dicliptera micranthes, Eragrostis tremula* (sandy ground).

e. Ruins and rubbish heaps :—

Fleurya interrupta, Lindenbergia.

f. The following are naturalized in waste ground, often remote from villages :—

Jatropha gossypifolia, Anona squamosa (sandy soils), *Argemone mexicana, Parkinsonia aculeata* (cotton soil), *Mimosa pudica* more humid districts only), *Tridax procumbens, Martynia diandra* (r.s.), *Hyptis suaveolens, Datura fastuosa, Scoparia dulcis* (r.s)., *Alocasia macrorrhiza* (wet ground near villages).

3. Marshes, margins of tanks, etc. (see also moist waste ground) :—

Ranunculus sceleratus (N.T. only), *Polycarpon Lœflingiæ, Ammania* spp., *Cyathocline lyrata* (but chiefly on rocks in shade along streams), *Grangea, Sphæranthus, Gnaphalium, Cæsulia, Jussieua* spp. (*J. fissendocarpa* in Purneah only), *Smithia conferta, Pentapetes phœnicea, Drosera Burmanni* (damp sandy ground), *D. indica, Osbeckia chinensis, Sphenoclea, Hydrolea, Dopatrium, Limnophila gratioloides, L. sessiliflora,* etc., *Asteracantha, Hygrophila angustifolia, H. quadrivalvis, Lippia geminata, Chenopodium ambrosioides, Polygonum* spp., *Ficus heterophylla, Sagittaria, Butomopsis, Typha, Phragmites* (near running water), *Elytophorus, Leersia hexandra, Isachne australis, Sacciolepis, Hymenachne, Panicum repens, P. proliferum, Floscopa scandens, Xyris pauciflora, Monacharia hastata, M. vaginalis.*

4. Saline marshes. The only saline marshes are those coming into the area of greatest humidity (see p. 59).

5. Rivers (excluding true aquatics. See also marshes) :—

a. River banks :—

Ranunculus sceleratus (N.T. only and banks of Sone), *Cochlearia flava, Pulicaria foliolosa* and *crispa, Celsia, Salvia plebeja, Cotula, Campanula canescens, Hygrophila polysperma, Vitex leucoxylon, Rumex maritimus* and *dentatus, Saccharum munja, Sorghum halapense.*

b. River beds (plants not in the water) :—

Dentella repens, Tamarix ericoides, Enhydra fluctans, Volutarella, Cryptocoryne (also under water as an aquatic), *Eragrostis stenophylla, Nephrodium proliferum.*

c. River beds, plants with roots in the water :—

Wedelia calendulacea, Spilanthes acmella, Veronica anagallis, Sutera glandulosa* (and marshes), *Polygonum hydropiper, P. glabrum, Cyperus tegetum, Phragmites, Crinum defixum.*

d. On or among the rocks of rocky river beds :—

Homonoia, Rhabdia lycioides.

6. Village lands :—

a. Cultivated :—

i. Rice-fields (mostly after the water has subsided. See also marsh lands) :—

Wahlenbergia, Hydrolea, Herpestis, Limnophila, Vandellia and many other small *Scrophulariaceæ, Utricularia cærulea* and other spp. (often climbing on the rice-stems), *Dysophylla verticillata, D. crassicaulis, Ammannia* spp., *Blyxa oryzetorum, Elytrophorus, Panicum humile, Echinochloa colona, Ischæmum rugosum* (when dry). *Eriocaulon quinquangulare, E. Sieboldianum, Cyanotis axillaris, Aneilema vaginatum, Aneilema spiratum* and others.

ii. On the bunds between the rice-fields :—

Melochia corchorifolia, Canscora decurrens, Sopubia.

iii. Higher level fields :—

† Chiefly in Northern tract :—

Nigella, Fumaria, Capsella, Thlaspi, Saponaria, Stellaria media, Spergula arvensis and *pentandra, Medicago lupulina, Cnicus arvensis, Convolvulus arvensis, Ageratum conyzoides.*

†† Also or chiefly in Central and Southern tracts:—

Emilia sonchifolia, Cnicus arvensis, Anagallis arvensis, Vinca pusilla, Physalis minima, Solanum nigrum, Leucas cephalotes, L. aspera, L. linifolia, Orobanche (root parasite, chiefly in tobacco fields), *Celosia argentea, Chenopodium album, Blumea oxyodonta, B. lacera, Asphodelus tenuifolius.*

b. Uncultivated (hedges, spontaneous on trellises, etc.). Pastures, rubbish-heaps and ruins are included under waste lands :—

Cassia sophera, Capparis horrida, Kirganelia reticulata, Celastrus paniculata, Ichnocarpus, Pergularia extensa, Cryptolepis, Ipomœa obscura, I. hederacea, Peristrophe bicalyculata, Leonurus sibirica (N.T. only), *Commelina suffruticosa.*

III. AQUATICS :—

a. General :—

Ceratophyllum, Naidaceæ, Hydrilla, Lagerosiphon, Vallisneria, Cryptocoryne (also flowering after drying up of the water). Hooker mentions as occurring in the Kymore Hills *Damasonium* (*Ottelia*), *Villarsia* (*Limnanthemum*), *Aponogeton*, 3 species of *Potamogeton*, 2 of *Naias*, and *Zanichellia.*

b. Running water :—

i. In the forest under shade :—

Eriocaulon rivulare.

ii. In the open :—

Ottelia, Eriocaulon setaceum, Monocharia hastata (slow running water).

c. Still waters :—

Myriophyllum, Jussieua repens, Trapa, Limnanthemum, Ipomœa reptans, Achyranthes aquatica, Hydrocharis, Pistia stratiotes, Lemna, Hygrorhiza aristata, Eichornia crassipes (and back waters of rivers).

* Hooker speaks of a *Veronica* on the shaded banks of the Sone, probably *V. anagallis* var. *punctata.*

177. Number of Genera and Species in each Family.

Family.	Number of genera.	Indigenous or feral species.	Species only cultivated.	Total described species.
PTERIDOPHYTA :—				
1. *Cyatheaceæ*	1	—	1	1
2. *Polypodiaceæ*	26	40	—	40
3. *Parkeriaceæ*	1	1	—	1
4. *Gleicheniaceæ*	1	1	—	1
5. *Schizeaceæ*	1	3	—	3
6. *Marattiaceæ*	1	1	—	1
7. *Ophioglossaceæ*	3	4	—	4
8. *Salviniaceæ*	2	3	—	3
9. *Marsiliaceæ*	1	1	—	1
10. *Equisetaceæ*	1	2	—	2
11. *Lycopodiaceæ*	1	4	—	4
12. *Selaginellaceæ*	1	11	—	11
Total	40	71	1	72
GYMNOSPERMEÆ :—				
1. *Cycadaceæ*	1	2	2	4
2. *Coniferæ*	3	1	3	4
3. *Gnetaceæ*	1	1	—	1
Total	5	4	5	9
ANGIOSPERMEÆ :—				
Dicotyledons :—				
1. *Ranunculaceæ*	5	10	—	10
2. *Dilleniaceæ*	1	3	—	3
3. *Magnoliaceæ*	3	1	2	3
4. *Anonaceæ*	8	15	1	16
5. *Menispermaceæ*	6	7	—	7
6. *Berberidaceæ*	1	1	—	1
7. *Nymphæaceæ*	3	5	—	5
8. *Papaveraceæ*	2	1	1	2
9. *Fumariaceæ*	1	1	—	1
10. *Cruciferæ*	11	15	2	17
11. *Capparidaceæ*	4	11	—	11
12. *Violaceæ*	2	3	1	4
13. *Bixaceæ*	2	1	1	2
14. *Flacourtiaceæ*	4	9	—	9
15. *Pittosporaceæ*	1	1	—	1
16. *Polygalaceæ*	2	8	—	8
17. *Caryophyllaceæ*	6	8	—	8
18. *Portulacaceæ*	1	4	—	4
19. *Aizoaceæ*	2	6	—	6
20. *Elatinaceæ*	1	2	—	2
21. *Tamaricaceæ*	1	3	—	3
22. *Hypericaceæ*	1	3	—	3
23. *Guttiferaceæ*	4	4	1	5

Family.	Number of genera.	Indigenous or feral species.	Species only cultivated.	Total described species.
24. *Ternstroemiaceæ*	1	—	1	1
25. *Dipterocarpaceæ*	1	1	—	1
26. *Malvaceæ*	13	36	9	45
27. *Sterculiaceæ*	12	22	3	25
28. *Tiliaceæ*	5	29	1	30
29. *Euphorbiaceæ*	42	86	17	103
30. *Callitrichaceæ*	1	1	—	1
31. *Linaceæ*	4	3	2	5
32. *Malpighiaceæ*	4	3	2	5
33. *Zygophyllaceæ*	4	3	1	4
34. *Geraniaceæ*	4	5	2	7
35. *Balsaminaceæ*	1	1	—	1
36. *Rutaceæ*	15	19	3	22
37. *Simarubaceæ*	1	1	—	1
38. *Ochnaceæ*	1	2	—	2
39. *Burseraceæ*	4	5	1	6
40. *Meliaceæ*	13	17	1	18
41. *Icacinaceæ*	1	1	—	1
42. *Olacaceæ*	3	4	—	4
43. *Ilicaceæ*	1	1	—	1
44. *Celastraceæ*	5	7	—	7
45. *Hippocrataceæ*	2	3	—	3
46. *Rhamnaceæ*	6	13	—	13
47. *Ampelidaceæ*	2	25	—	25
48. *Staphyleaceæ*	1	1	—	1
49. *Sapindaceæ*	10	9	5	14
50. *Sabiaceæ*	2	2	—	2
51. *Anacardiaceæ*	8	8	—	8
52. *Moringaceæ*	1	1	—	1
53. *Papilionaceæ*	58	179	21	200
54. *Cæsalpiniaceæ*	15	28	17	45
55. *Mimosaceæ*	12	31	6	37
56. *Rosaceæ*	8	9	6	15
57. *Saxifragaceæ*	1	2	—	2
58. *Crassulaceæ*	2	3	—	3
59. *Droseraceæ*	2	4	—	4
60. *Halorrhagaceæ*	1	2	—	2
61. *Rhizophoraceæ*	6	9	—	9
62. *Combretaceæ*	6	11	2	13
63. *Myrtaceæ*	7	9	13	22
64. *Lecythidaceæ*	2	3	—	3
65. *Melastomaceæ*	4	9	—	9
66. *Lythraceæ*	6	16	2	18
67. *Onagraceæ*	3	6	—	6
68. *Turneraceæ*	1	1	—	1
69. *Passifloraceæ*	1	1	—	1
70. *Caricaceæ*	1	1	—	1
71. *Cucurbitaceæ*	14	20	6	26

Family.	Number of genera.	Indigenous or feral species.	Species only cultivated.	Total described species.
72. *Begoniaceæ*	1	1	—	1
73. *Cactaceæ*	4	3	4	7
74. *Umbelliferæ*	12	19	4	23
75. *Araliaceæ*	5	4	2	6
76. *Cornaceæ*	1	2	—	2
77. *Rubiaceæ*	32	66	9	75
78. *Compositæ*	58	92	11	103
79. *Stylidaceæ*	1	2	—	2
80. *Campanulaceæ*	5	12	—	12
81. *Plumbaginaceæ*	2	2	2	4
82. *Primulaceæ*	4	5	—	5
83. *Myrsinaceæ*	4	6	—	6
84. *Sapotaceæ*	4	5	1	6
85. *Ebenaceæ*	2	10	2	12
86. *Styraceæ*	2	3	—	3
87. *Oleaceæ*	6	14	1	15
88. *Salvadoraceæ*	2	2	—	2
89. *Apocynaceæ*	22	20	13	33
90. *Asclepiadaceæ*	23	34	2	36
91. *Loganiaceæ*	4	5	—	5
92. *Gentianaceæ*	6	12	—	12
93. *Hydrophyllaceæ*	1	1	—	1
94. *Polemoniaceæ*	2	0	2	2
95. *Boraginaceæ*	8	21	—	21
96. *Convolvulaceæ*	17	52	9	61
97. *Solanaceæ*	9	14	12	26
98. *Scrophulariaceæ*	25	55	6	61
99. *Orobanchaceæ*	2	4	—	4
100. *Lentibulariaceæ*	1	9	—	9
101. *Gesneraceæ*	3	3	—	3
102. *Bignoniaceæ*	12	9	20	29
103. *Pedaliaceæ*	3	2	1	3
104. *Acanthaceæ*	34	73	17	90
105. *Verbenaceæ*	17	40	5	45
106. *Labiatæ*	27	61	8	69
107. *Nyctaginaceæ*	4	4	3	7
108. *Amarantaceæ*	10	21	1	22
109. *Chenopodiaceæ*	7	7	4	11
110. *Phytolaccaceæ*	1	1	—	1
111. *Polygonaceæ*	4	23	2	25
112. *Podostemonaceæ*	1	1	—	1
113. *Aristolochiaceæ*	1	3	—	3
114. *Piperaceæ*	2	6	2	8
115. *Lauraceæ*	8	11	3	14
116. *Hernandiaceæ*	1	1	—	1
117. *Proteaceæ*	1	1	—	1
118. *Elæagnaceæ*	1	1	—	1
119. *Loranthaceæ*	2	7	—	7

Family.	Number of genera.	Indigenous or feral species.	Species only cultivated.	Total described species.
120. *Santalaceæ*	2	2	—	2
121. *Balanophoraceæ*	1	1	—	1
122. *Ulmaceæ*	3	5	—	5
123. *Cannabinaceæ*	2	1	1	2
124. *Urticaceæ*	8	14	—	14
125. *Moraceæ*	8	30	9	39
126. *Salicaceæ*	1	1	—	1
127. *Casuarinaceæ*	1	1	—	1
128. *Ceratophyllaceæ*	1	1	—	1
Total	819	1585	271	1856
MONOCOTYLEDONS:—				
129. *Alismaceæ*	4	7	—	7
130. *Naiadaceæ*	5	16	—	16
131. *Hydrocharitaceæ*	6	8	—	8
132. *Araceæ*	22	24	7	31
133. *Lemnaceæ*	2	6	—	6
134. *Typhaceæ*	1	2	—	2
135. *Pandanaceæ*	1	2	—	2
136. *Cyclanthaceæ*	1	1	—	1
137. *Palmaceæ*	11	15	5	20
138. *Cyperaceæ*	16	120	—	120
139. *Gramineæ*	90	207	11	218
140. *Eriocaulaceæ*	1	11	—	11
141. *Xyridaceæ*	1	3	—	3
142. *Flagellariaceæ*	1	1	—	1
143. *Commelinaceæ*	6	19	2	21
144. *Juncaceæ*	1	2	—	2
145. *Liliaceæ*	19	19	13	32
146. *Hæmadoraceæ*	1	1	—	1
147. *Stemonaceæ*	1	1	—	1
148. *Pontederiaceæ*	2	3	—	3
149. *Amaryllidaceæ*	17	13	14	27
150. *Taccaceæ*	1	1	—	1
151. *Bromeliaceæ*	2	0	2	2
152. *Dioscoreaceæ*	1	11	2	13
153. *Burmanniaceæ*	1	1	—	1
154. *Iridaceæ*	3	0	3	3
155. *Musaceæ*	3	2	3	5
156. *Zingiberaceæ*	9	31	5	36
157. *Cannaceæ*	1	1	—	1
158. *Marantaceæ*	4	3	2	5
159. *Orchidaceæ*	28	70	3	73
Total Monocotyledons	262	601	72	673
Total Angiosperms	1241	2186	343	2529

CHAPTER V.

NOTES ON THE HAZARIBAGH AND MONGHYR FLORAS.

178. There is a very good account of the Botany of the Hazaribagh district in the *Gazetteer* (1917) by the Rev. S. L. Thompson, formerly Principal of St. Columba's College, Hazaribagh, which I have not reproduced as it is readily accessible. In this he states that there are no less than 11 *Utricularias*, two of which have not been reported from the province and are very minute, growing among moss. Unfortunately he does not enumerate the species, especially as the present Flora only records 9 species of *Utricularia* from the whole province. Mr. Thompson's full results would have been a welcome contribution to this book had they been available. The following passage of Mr. Thompson's account bears on the subject of the pitiful devastation of the forests: "Unfortunately no report on the Hazaribagh flora can omit the most striking fact about it, *i. e.* its rapid disappearance. The forest is being most wastefully destroyed, and with it a great number of plants of great botanical and economical interest are becoming extinct. Mutilated stumps are all that remains of many valuable trees like *Dillenia aurea*, *Sterculia villosa*, *Kusum*, *Paisar*, *Dalbergia latifolia*, *Soymida* and *Ailanthus excelsa*, where even ten years ago there was considerable jungle. Whether one considers the disastrous effect on the cultivated fields lying below the ruined jungle, or the loss to the villagers of their invaluable forest produce, or merely the botanical loss, this is by far the most important fact about the vegetation of Hazaribagh."

179. For the most part the other accounts of the Botany in the district gazetteers are meagre, and antiquated in nomenclature. The source of the information is rarely given, but there are seldom positive errors as, for instance, the allusion to the "graceful festoons of *Spiræa* and masses of Cactus in the Gaya Hills," where, no doubt, the *Porana* and *Euphorbia* are alluded to.

180. A general description of the botany of Monghyr is given in the *Forest Flora of Monghyr* (*Statistical Reporter*, 1877), and also a more detailed account by Buch.-Hamilton in his MS., which are here partly reproduced. In the first publication the author states that among survivals the Cotton tree, spectre tree (*Sterculia urens*) and screwpod (*Helicteres*) are common on all sides, while many other species of *Hibiscus* appear as annuals or undershrubs. The pea family, after the mallows, is the commonest of all, and here we have tamarind, Indian laburnum, flame tree (*Butea*), purple azalea pea (*Bauhinia variegata*), and many acacias and mimosas. Nor must the Karzanis (*Abrus precatorius*) be forgotten as its vermilion seeds are conspicuous in every part of the jungle during the cold season. The frankincense tree is found throughout the hills; as fuel it gives out such dense clouds of smoke

that nobody cares to burn it. Next in numerical order come the Dog-banes, which are always conspicuous in the cold weather with their long pods enclosing seeds winged with a tuft of silken hairs. These when ripe burst open and are borne by the wind to any square inch of ground that may be without a tenant. The Peruvian bark family is well represented. The Nepaul lilac (*Hamiltonia suaveolens*) is one of the few common plants with fragrant flowers which adorn the hills in the cold season, and when this and the red chamber candle (*Holmskioldia*) grow side by side, they stand out in beautiful relief against the background of dark green trees. Then belonging to this family is the Indian cinchona (*Hymenodictyon*), which may always be recognized during the cold season by its brown capsules containing winged seeds hanging in clusters on the wintry leafless branches. An account of the trees would be incomplete without mention of the *Terminalias*, which, given fair play, would grow into large trees. There is the fly-wheel *Terminalia*, whose winged fruit looks like the miniature screw of a steamer, and the dhao, which is very common, and commands as fuel by far the best price in the Monghyr market.* Then there are the tan trees (*Terminalia belerica* and *chebula*), which, however, are becoming scarce. There is also the Kawa (*T. Arjuna*).

181. The author then proceeds to give a list of 153 trees and shrubs, from which I have selected the following most interesting or characteristic (he included a large number of cultivated ones) with his remarks, and added the names where necessary† :—

Tinospora cordifolia (Guruj), *Capparis horrida* (Bagnai), *Flacourtia Ramontchi* (Baincha ; Banj Baincha is the male), *Tamarix dioica* (Jhau) on diaras along the Ganges. Sal, Sakwa ; all the forests are properly speaking Sal forests, but it would be difficult to find half a dozen full-grown trees left. *Kydia calycina* (Dhamin), *Sterculia urens* (Mogul, Karaunji), *Helicteres* (Ainthia dhamin), *Hiptage madablota* (madmalta), *Zanthoxylum alatum* (Gaira) [no doubt *Limonia acidissima*], Grewia pilosa (Ghorkund): [probably *Grewia hirsuta*]. *Murraya exotica* (Ban mirchi). *Feronia elephantum*, not uncommon in the jungles. *Ægle marmelos*, common. *Boswellia serrata* (Sale). *Balsamodendron mukul* (gugal) in the gardens. *Olax scandens* (Arthil, chigas). *Zizyphus œnoplia* (markhoa). *Z. xylopyra* (Ghunt), common. *Schleichera trijuga*, most of the large trees cut down. *Sapindus laurifolius* (Ritha), cultivated. *Semecarpus anacardium*, common *Buchanania latifolia* (Piar), most of the large trees cut for timber and fuel [*sic*]. *Butea frondosa* and *B. superba*. *Ougeinia dalbergioides*, not uncommon in the hills. *Cæsalpinia bonducella*, common in hedges (kat kareza). *Colvillea racemosa*, thrives well in Monghyr. *Acacia Farnesiana* (Guhiya Babul). *A. Catechu*, very common on the hills. *Combretum decandrum* (Madlat). *Woodfordia floribunda* (Dhaula). *Randia dumetorum* (Man), common. *Embelia robusta* (Babari). *Diospyros melanoxylon* (Kend, Abnus), common. *D. montana* (Makr Kend), not uncommon. *Carissa diffusa* (Karaundas),

* Apparently the *Anogeissus latifolia* was considered to be a *Terminalia*.
† My own remarks are in *square* brackets.

general in the hills [probably *C. paucinervia* var. *opaca*]. *Wrightia tomentosa* (Dudh Koraiya), rare. *W. tinctoria* (Chhota dudh Koraiya). *Holarrhena antidysenterica* (Dudhi). *Ichnocarpus frutescens* (Dudh latta). *Calotropis gigantea* and *C. procera* (Madar), common. *Marsdenia tenacissima* (Sitti, har chikkar), occasional on the hills. *Porana paniculata* (Burhi lat). *Stereospermum suaveolens* (Parar). *Clerodendron phlomidis* (Bhant), at Bhimband in Kharakpur Hills. *Cl. infortunatum* (Tit bhant) in every grove and hedge. *Streblus asper* (Sahora). *Ficus repens* (khoksa) in marshy country north of the Ganges [see under *F. heterophylla*]. *Sponia* (*Trema*) *orientalis* (Jhungjuni). [Hamilton refers to "Jhungjuni as the large-leaved *Grewia orientalis* mentioned by Willdenow. A small useless tree growing about villages in Bhagalpur." I don't know which *Grewia* he can mean by this.] *Croton oblongifolius* (Puter). One of the most abundant trees in the hills, chiefly as an undershrub owing to being cut. *Jatropha glandulifera* (Belati bagandi), said to have been introduced about 30 years ago, now found all over the district. *Briedelia retusa* (Khaj) common in the hills. *Phyllanthus emblica* (Aura), general. *Breynia rhamnoides* (Sikkat), hedges. [I suspect this is *Kirganalia*.] *Salix* (Bes), North-east of Ganges. [No doubt *S. tetrandra*.]

182. The following additional plants* and information or additional vernacular names are added from Buchanan-Hamilton's MS. of the survey of Bhagalpur, which then included Monghyr and the Santal Parganas.

The most common wild bamboo is called "Tanai bangs" [no doubt *Dendrocalamus strictus*]. "Khajur" (*Phœnix sylvestris*). It does not sucker like the true date. Abundant. Is fit for being tapped when 10 years old, and lasts 20 years more. Season commences beginning of October and lasts 5 months or more. The juice is called Mitha Tari [sweet toddy]. "Tal" or "Tar" (Borassus) perhaps as common as last. Far less tapped and juice less sweet. Begins to yield about the middle of March and season lasts 2 months. Begins to flower between 25 and 40 years old, and continues to a great age. The spadix is cut 3 times a day from the point of the unopened spathe until it withers. New spadices shoot in succession. In Bhagalpur only the male spadices are cut, but I am told that after fruit ripens in Aug. or Sept. the female may be cut.

183. "Harila" (*Terminalia chebula*). [Hamilton considers the tree different from the "Haritaki" of Bengal and the Mysore tree.]

Terminalia tomentosa, "Asan." [The system of pollarding the trees described by him for feeding the Tasar is the same as is practised in Chota Nagpur; his account of the ritual observed is full and interesting. He discriminates between the "Kahu" and the "Arjan" (*T. arjuna*). He says the latter tree more resembles the "Kahu" than it does the "Asan," and was only seen in the south-east of the district. But I consider that these are two vernacular names for the same tree. I have, however, observed hybrids of *T. arjuna* and *T. tomentosa*, and his Kahu may have been one of these.]

* The determinations are mine own. These were made easy by Hamilton's remarks and classification.

[Similarly he says that "Dha" must be distinguished from "Dhao," but may belong to the same genus. He says the latter is the name used by the Northern Mountaineers (by which term he refers to the Mal Paharias of the northern Santal Parganas). "Dha" and "Dhao" also I consider to be the same tree, viz., *Anogeissus latifolia.*]

184. "Morawa" of the Mungger Hills [he describes as a fine species of *Vitex* seen nowhere else. This is doubtless the *Vitex glabrata*, probably now extinct in Monghyr, though still found in the Rajmahal Hills.]

"Dantranga," *Ehretia levis.* The bark used to stain the teeth red. *Schrebera* called "ja" in the woods of Bangka and "Ghatera" in south of Mungger is very common in the former. It is allied to the *Bignonia* and has not the smallest affinity to *Schrebera albens* of Willdenough. [Ja is doubtless *Schrebera swietenioides*, while "Neuri," which he mentions later on as *Schrebera albens*, Willd. is *Elæodendron glaucum*, common in the woods of Bangka. Banka or Bangka (as spelt by Hamilton) is shown on the map attached with a range of hills and some unreserved jungle on them in the south of Bhagalpur.]

185. *Strychnos nux-vomica*, "Kungchla," common in the southern hills. [This record is interesting as the tree is now only abundant in Puri.] "Mahul" or "Mahuya," *Bassia latifolia*, in great quantities.

Mimusops elengi, "Maleswari" at Bhagalpur, but in the woods of the south "Baul." This reference to *M. elengi* as *wild* in the southern part of Bhagalpur is interesting as the tree is usually not considered wild north of the Deccan.

"Khirni" or *Achras dissecta*, Willd. is evidently *Mimusops hexandra.* He says "woods of Mungger, very common and fruit sold on the market. Coarse furniture made from the wood."

"Makarkand, *Diospyros cordifolia*, fruit excessively bitter." [Possibly this is *D. montana*, which is not otherwise mentioned, although another Makarkand is referred to. This latter was one of the *Rubiaceæ* but the information given is insufficient to identify it.] "Gab," *Diospyros embryopteris.* "Kend," *D. melanoxylon*, produces a black heart called "abnus" [ebony].

"Hyal," *Barringtonia acutangula*, on the banks of every river and in the marshy woods on the north side is the only tree that grows.

186. In the drier woods one of the most common trees is called "Dungruki" in Lakardewani and "Harhar" near Mungger. It is a species of *Gardenia* close to the "Dhaniya" of Purneah and perhaps the same. The fruit possesses saponaceous quality. Wood formerly used for sepoy drums and even now is employed for the hoops. It is very flexible and does not split. [This must be, I think, *Gardenia turgida.*] "Popro," a very common hill species [is certainly *G. latifolia.*] "Pindar" or "Pindalu," *Gardenia uliginosa* [*Randia uliginosa*]. "Gulte Karam," wood better than that of "Karam" (*Adina*) [is *Mitrogyna parvifolia*]. He then enumerates the following *Rubiaceæ*: 52. "Tilai." 53. "Khangta," a species of *Ixora*, *I. arborea* of Dr. Roxburgh's MS. 54. Another called "Chhota Khongtu." 55. A third called "Maruya." 56. Towards Virbhum, a tree called "Burha," greatly resembling the last, but without flowers or fruit. 57. "Makarkand" (see para. 185),

no fl. or fr. 58. "Putal." 59. "Banakangro." [These I can only partly identify as 52. *Wendlandia* sp. 53. *Ixora parviflora.* 54, probably the same as 53. 55 and 56. *Pavetta indica.* Nos. 57–59 I cannot identify, but one is likely to be *Canthium didymum.*]

Garcinia sp., each berry with 4 seeds [probably *G. Cowa*].

"Sakuya," *Shorea robusta.* Resin extracted from trees not thicker than a man's arm, by cutting a ring of bark 6″ wide about 2 ft. from the ground. I everywhere saw trees cut. The dhuna (resin) is used as incense. [*Cp.* p. **57**.]

"Tita kangta" or "Gira," *Limonia acidissima.*

"Sale, Salhar, or Sondar," *Boswellia serrata.* [Yields gum which Buchanan-Hamilton rightly insists is not the *Olibanum* of the bazars or the true *Olibanum.* The latter is probably imported from Arabia. According to Colebrooke (*Asiatic Researches*, vol. ii), whom he refutes, the olibanum, or frankincense of the ancients, was the product of this tree. Much olibanum is imported into Bombay from Somaliland.]

"Phulka," *Sterculia colorata*, hills of Monghyr.

187. "Hiran" or "Chhota Gandhai" and "Gandhai" or "Gandhana Hiran" are described as species of *Uvaria.* He describes the first as very useful to the turner. [These trees are no doubt *Miliusa velutina* and *Saccopetalum tomentosum* respectively.] Further on he says that the "Hiran" of Lakardewani* seems very different from that of Mungger (the first mentioned), and seems from its leaf to be rather a *Tomex* than an *Uvaria.* The fruit is said to be esculent. [This is probably *Litsœa polyantha,* which sometimes is called by the same vernacular name as the *Saccopetalum*, and the leaves of which have somewhat the same smell.] Two other species of *Lauraceœ* are mentioned: the "Gidha" "with somewhat the appearance of a Laurus, and leaves sometimes alternate, sometimes opposite or collected" [might be a *Machilus*, but none is known from Monghyr, and it is more probably *Litsœa sebifera*], and "Jugya of Banka, with alt. cordate leaves with the appearance of *Uvaria.*" [I don't know what laurel this could be.]

188. The "Phalsa" of Monghyr is called in the woods of Banka "Dhaman." It grows to be a tree. [Apparently *Grewia Hainesiana.*] "Singgiya Dhaman" is stronger and is the *Grewia arborea* of Roxburgh's MS. [Probably *G. tiliœfolia.*] "Arhariya Dhaman" is also a *Grewia.* [There is a specimen of this in the Wallichian Herbarium called by Hamilton *Grewia araria*, collected May 26th, 1811. It is one of the critical forms and apparently *Grewia elastica* forma *a* of the Flora, p. **93**, with leaves narrower than usual, or a hybrid of this and *G. Rothii.* I have met with exactly similar forms in other districts of the Central area.] "Jhungjhuni," see p. 72.

"Galgal," *Cochlospermum Gossypium.*

189. "Thanki" is a very common tree throughout the southern woods, and the Tasar feeds on it. It is sometimes called Nilkar, and is also used in medicine. It is certainly the Kasjavomaram of Rheede.

* Lakardewani was a large pargana to the south and east of Pargana Banka and partly in what is now the south of the Santal Parganas. It is dotted with detached rocky hills and was covered with wood in Hamilton's time.

[This latter is evidently a species of *Memecylon* and its occurrence in Monghyr is very interesting.]

"*Alangium tomentosum*" of the *Encyclopædia*, very common in the woods. Called "Dhela" and grows to a considerable size [= *Alangium Lamarckii*.]

"Sidda." Tasar often found on its leaves [*Lagerstrœmia parviflora*].

Nos. 107–110 are species of *Eugenia*.

Nos. 115–121 are species of Acacia. *Erythrina indica*, "Pharhar." Another species in the woods of Kharakpur, *E. alba* of Roxb. Near Birbhum it is called "Mandar" [*Erythrina suberosa*].

"Pangdan," leaves very like an *Erythrina*, but the flowers approach a *Glycine*. It is a fine tree, but has a kindred species which is an immense climber. [This is *Ougeinia dalbergioides*, and the climber, perhaps, *Butea parviflora*.]

"Paras," *Butea frondosa*, also has a kindred climber = *B. superba*.

"Murga" = "Paysar" of Kharakpur [*Pterocarpus Marsupium*].

"Chagalnadi" of the Mungger Hills is a *Dalbergia* of no use, but grows in all situations, on the parched rocks of Mungger and the half-drowned banks of Dhaka. [This can only be *D. lanceolaria*.]

"Jiyal" = "Doka" of Bangka and "Kasambar" in the woods of Tarapur, but the tree called "Kasambar" in Mungger and "Parmi" in Tarapur is different and = Katow Kalesiam of the *Hortus Malabaricus* (iv, pl. 33). [The first of these two trees is *Odina Wodier*, the second is *Garuga pinnata*.] "Amsaheri" of Mungger, "Saheri" of Bangka is a species of *Schinus*. Fruit eaten. Leaves and bark used in medicine. Timber takes a good polish. [It is probably *Bursera serrata*.]

190. "Kadrupala" in Bangka, *Clutia stipularis* [*Bridelia stipularis*]. "Namta," also a *Clutia*. Its berries are eaten; [is probably *Bridelia retusa*, though this species is often called Kadrupala]. "Haril" and another species of "Bradleya" [are species of *Glochidion*]. "Palasi" allied to "Aongla" (*Emblica*) [I cannot identify].

191. Hamilton enumerates 7 figs. which are referable to *F. bengalensis* ("Bar"), *F. Arnottiana* ("Khota pipar"), *F. religiosa*, *F. Rumphii* ("Pakar"), *F. infectoria* ("Pakar"), *F. glomerata* (Gular, Bara Dumar, Yog Dumar"), also another fig allied to *F. glomerata* with "figs size of a small apple and also called Gular," and a fig called Gadha Bar, which is very common and also sends roots from the branches; [the latter is probably *F. tomentosa*].

"Chulmuli," of woods of Karakpur [*Holoptelea integrifolia*].

"Tilai" with very rough leaves [*Trema politoria*], "Chamari Tilai" [*T. orientalis*]. "Amtiya" in Bangka, "mamroja" at Mungger "kshir" in Purneah and "mangjari sag" by the physicians [*Antidesma diandrum*]. "Matisura" of Bangka, "tarsi" of Mungger [*Antidesma Ghæsembilla*]. "Pitangjira" [Putranjiva].

CHAPTER VI.

TAXONOMY AND CLASSIFICATION.

Principles: Arrangement should be phylogenetic, 192; Difficulties, 193; Parallel development, 194; The archegoniatæ, 195; Relative age of Gymnosperms and Pteridophyta, 196–200; Gondwana-land, 197; Primofilices, 198; *Rhyniaceæ*, 200; Hofmeister's theory, 201; Arrangement of the subdivisions of the Pteridophyta, 202; General arrangement of the Pteridophyta and Spermophyta according to Scott, 203; Arrangement of the subdivisions of the Pteridophyta based on Bower and Scott, 204–207. **The Angiosperms**, 208–221; Arrangement of the subdivisions of the Angiosperms, relative age indeterminable from geological record, 208; Similarity of Dicotyledons to *Gymnosperms* compared with Monocotyledons, 209; Points of resemblance of some orders to the *Gnetales*, 210–213; Points of resemblance of some orders to the *Cycadeoids*, 214, 215; View of Arber and Parkin, 216; View adopted in this Introductory Synopsis, 217; Arrangement adopted in the body of the Flora different, reasons, 218; Endlicher's system, 219; Hutchinson's outline, 220; Position of the Monocotyledons, 221. **The System adopted**:—**Synopsis of Classes, Orders and Families**: Main divisions of the Vegetable Kingdom, 222; Pteridophyta, 223; *Lycopodineæ*, 224; *Equisetineæ*, 225; *Filicineæ*, 226; *Spermophyta* or *Phanerogamia*, 227; Division of the Phanerogams, 228; Gymnospermæ, 229; Angiospermæ, 230 (p. 90); **Class Dicotyledones**, 231, pp. 91–144; Arrangement according to Bentham & Hooker, 232; Arrangement, based on preceding discussion, of the families occurring in Bihar and Orissa, 233; Conspectus of the Choripetalous groups, 234; (p. 92.) Descriptions of Orders and Families of the Choripetalæ, 235 (pp. 97–131); Gamopetalæ, 236; Origin of the Gamopetalæ, 237; Conspectus of the Gamopetalous groups, 238; Descriptions of the Orders and Families of the Gamopetalæ, 239 (pp. 133–144); **Class Monocotyledones** 240; Descriptions of Orders and Families of the Monocotyledons, 241 (pp. 145–155).

192. A philosophic natural classification should, if the theory of evolution be maintained, be based on that theory, and although no linear arrangement of families can adequately express the relation of different phyla, the arrangement should, so far as possible, be phylogenetic. The groups derived from the supposedly more primitive ancestors should logically come first. But as each phylum and its branches evolve, the later subdivisions will have receded much further from the original stocks than have some or all of the families of other phyla which, in a linear arrangement, have to be placed subsequently. Such returns to less evolved phyla, or breaks in a phylum, where it is necessary to take up a new group, can be partly indicated by a new heading, name of the new phylum, a break or line, and the supposed allied group or groups to which references back or forward should be made are sometimes also pointed to with an arrow.

193. The real difficulty of a phylogenetic arrangement is our ignorance of the true relationship of so many families and of the real origin of any of them.

194. Even the relative position of the main groups such as Bryophyta, Pteridophyta, Pteridosperms, Gymnosperms and Angiosperms, which once appeared satisfactorily settled, are again under discussion. It has even been suggested that the different groups of vascular

plants have originated independently, and at different times in the history of the world, from the marine algæ.* It is asserted that such persistent, and on the whole uniform, morphological structures as the archegonium are not necessarily homogenetic, but that their similarity in structure through the most varied groups are merely cases of homoplasy or parallel development under the influence of constantly recurring conditions. In other words that, under given conditions, " there are a limited number of ways in which protoplasm can react."† Allied to this theory is that of *Phyletic Drift*. Bower (*Nature*, March 8th, 1924) states that by this term it is meant to convey that along a plurality of nearly related evolutionary paths, parallel but independent, a similarity of structure has been reached. He quotes as an instance the slide of the sorus from the margin of the leaf to the under surface, and says "there is no doubt that the primitive position was marginal; but along many phyletic lines . . . the sorus has passed . . . to a superficial position." That parallel development is of very frequent occurrence seems well established, but to find it on such a scale as is necessitated by this theory of the archegoniatæ appears to imply a want of plasticity in Nature at variance with our experience of her marvellous versatility. Witness the extraordinarily various forms of sexual apparatus in the marine algæ themselves under more constant conditions than could ever have applied to a terrestrial flora, or the even more varied reproductive organs of the fungi. In no group do the archegonia closely resemble the oogonia of marine Algæ.‡

195. The forms of archegonia appear to have undergone a retrogressive evolution such as might have been anticipated if the several phyla in which they occur were descended from some primitive archegonium-bearing stock. In the Bryophyta they are usually stalked and free and with a long multicellular neck. In the Pteridophyta the archegonia become sunk in the tissue of the thallus, the wall of the venter, which contains the oosphere, being formed from the tissue of the prothallium itself, bearing in fact such a relation to that of the Muscineæ as (though the cases are totally different) an inferior ovary does to a superior ovary. Further, in the Pteridophyta there is a progressive shortening of the neck which consists, as in most Muscineæ, of 4 rows of cells and a central canal (derived from a row of disorganized canal cells). This neck, shorter than in the Mosses, but consisting of several cells in length in the *Filices*, is only 2 cells in length in *Selaginella*. In the *Coniferæ* again the archegonia are formed from single superficial cells of the contained prothallium exactly as in the more typical archegoniatæ. Here also the neck consists of rosettes of 4 cells, but is reduced to one cell in length in some *Abietineæ*. The conditions of life in coniferous and angiospermous trees would appear to be very similar as compared with fern prothallia and tall conifers, yet it is precisely between the Angiosperms and Gymnosperms that the biggest step has been taken in the evolution

* Church, Tansley. † Tansley, Jan. 19th, 1924. ‡ The freshwater algæ groups Chætophoraceæ and Coleochætaceæ are sometimes considered nearer to the line of descent of the Archegoniatæ.

of the archegonia, which are now reduced to naked cells. Indeed the homology of these cells with archegonia is only deduced by their relation to other apparently homologous structures.

196. Granted that the Angiosperms are the youngest group and should be treated last in a phylogenetic arrangement, are the Gymnosperms or the *Pteridophyta* the older group? *i. e.* assuming that each of these really form homogenetic groups and do not consist of several phyla of independent origin as has been suggested.

197. Scott and other palæontologists have shown that many of the orders of Gymnosperms are of immense age. Many families of Gymnosperms and Ferns abound in the Mesozoic period; but in the Permo-carboniferous epoch the true Cycads and Conifers appear not to have arisen. There is, however, an important family, the *Cordaiteæ*, with somewhat generalized characters and undoubtedly Gymnospermous. There is also a very important and remarkable class of plants, once supposed to be ferns, known as the Pteridosperms or Seed-ferns. These seed-ferns had large fern-like leaves, but the anatomical structure rather of Gymnosperms and, as it has since been abundantly proved, bore *true seeds* resembling those of Gymnosperms. Dr. Scott states that the *Cycadophyta* were probably derived from the great plexus of Pteridosperms. The Pteridosperms are well represented in our area in the intertrappean rocks of the Rajmahal Hills and in the Panchet and Damuda rocks (*vide* Geology, p. 7). They were apparently a strong constituent of the great *Glossopteris* flora which was characteristic of various regions separated now by the ocean, but which once perhaps formed parts of the hypothetical continent known as Gondwana-land. Possibly that continent itself now hides beneath the ocean the long-sought-for evidences of the primitive Pteridosperms and the origin of the Angiosperms.

198. The Pteridosperms are quite as strongly represented in the Lower Carboniferous as in the upper beds (though the evidence is mainly from anatomy) whereas Gymnosperms are very rare. They occur also in the Upper Devonian, and as far back as the early Devonian a single fossil (*Palæopitys Milleri*) was either a Gymnosperm or Pteridosperm. No connecting link has as yet been found between the Pteridosperms and the ferns except their remarkable similarity in leaf.

In the early Devonian there is no satisfactory evidence for the presence of the Filices, and even the Primo-filices (a group apparently of true ferns; their sporangia are furnished with an annulus composed of *two* rows of cells, but without any lamina to the leaves) have only been found as far back as the Upper Devonian, although allies of the Lycopods were already flourishing. Precursors of the Sphenophylls (allied to the early Horsetails) were also present in the Middle Devonian.

199. On the geological record alone, therefore, it would appear that the Gymnosperms are of quite as old a stock as, if not older than, the Ferns, and on this record there appears to be some reason for supposing an independent origin not only for the Gymnosperms and Pteridophyta, but also for the Lycopods and Horsetails.

200. There is, however, a group of plants known as the Rhyniaceæ, the simplest and among the most ancient of land plants known, of which Dr. Scott writes, it is possible to interpret the family as a synthetic group, related to both the Vascular Cryptogams and the Bryophyta while still retaining some of the characters of the algal stock." Allied to or belonging to these Rhyniaceæ is a genus *Psilophyton*. The tips of the young branches were curled in a circinate manner like the young fronds of a fern. It had only small spines in the place of leaves—and we have already seen that the Primo-filices were without leaf lamina—and it bore long oval sporangia, often in pairs, on the ends of the fine branches. There is some evidence that this genus goes back to the Silurian, and if so, this would take the fern-stock lower down than is known for any Gymnosperm. But the general conclusion that one, who has himself no first-hand knowledge of fossil botany, comes to, is that the geological record is at present far too incomplete to settle the question : that if there is too little evidence to decide the monophyletic origin of the separate groups of Pteridophytes and Gymnophytes, still less is there direct evidence of connections between these and the several phyla of the marine algæ.*

201. Where geological history fails us it is necessary to fall back upon general morphological structure and the ontology of existing plants, and to form some workable hypothesis of descent which will tally with known facts. "A working hypothesis is very useful in stringing facts together ; if the thread breaks, a better one can often be found ; it is the pearls that are of value, not the thread" (*Lodge*). For the general arrangement of descent of many of the groups Hofmeister's researches still appear to show a connected logical arrangement.

202. As to the arrangement of the Pteridophyta among themselves, the system most in accordance with Hofmeister's views is to commence with the homosporous *Filicineæ* and to end with the heterosporous *Lycopodineæ*. This is the arrangement in the body of this Flora, which, however, differs from that usually adopted by my treating all the really fern-like families, whether lepto-sporangiate (archesporium a single hypodermal cell of an axile row) or eu-sporangiate (archesporium a group of cells), before the *Hydropterideæ* or water-ferns, which totally differ in foliage and in the formation of sporocarps.

203. Hofmeister's system adopted by most pteridologists is not, however, in unison with what is now known of the geological history of the Pteridophytes. The true ferns appear to have originated later than the Marattiales, the Horsetails or the Lycopods.

The following is the arrangement of the larger groups of Pteridophyta and Spermophyta based on fossil evidence, according to Scott † :

* Indeed there are not wanting biologists who maintain the thesis that organisms evolved first in fresh-water areas. See *The Causes and Course of Organic Evolution*, by J. M. Macfarlane, Chapter XI.

† *Studies in Fossil Botany*, third edition, ii, p. 395.

Psilophytales	Rhyniaceæ. Asteroxylaceæ.	
Lycopsida	Psilotales (?). Lycopodiales.	
Sphenopsida	Equisetales Sphenophyllales	Articulatæ.
Pteropsida	Filicales. Pteridospermeæ Gymnospermeæ Angiospermeæ	 Spermophyta.

Or, confining ourselves to existing Orders (and omitting Psilotales, which do not occur in our area), the Lycopodiales, Equisetales and Filicales are treated as three distinct phyla, but possibly all descended from a stock akin to the extinct Psilophytales, while there appears to be some connection, though with a large unfilled gap, between the modern Spermophytes and the Filicales, through the extinct Pteridospermeæ.

204. The above is somewhat at variance with the views of Hofmeister, who, it will be remembered, traced the descent of the seed-plants through allies of the heterosporous Lycopods. Heterospory has arisen, apparently as a parallel development, in all three phyla. Although not now existent in the Equisetales, it was prevalent in the extinct Calamostachys and other Calamarieæ.

205. In the following pages the relative position of the families within the Filicineæ (based on Bower and Scott's views) is therefore different to that usually adopted in systematic works (and in the Flora). The Eusporangiate ferns, in spite of their more complicated or more modified sporangia or sporangia-bearing leaves, are concluded to be relatively ancient to the Leptosporangiate and usually more delicate ferns.

206. Scott states that various facts connect the Marattiales with the primo-filices; the latter (*Botryopteridaceæ*) occur commonly in the Lower Carboniferous, the Marattiaceæ are known in the lower Coal-Measures of the Upper Carboniferous, while ferns of the Polypodiaceæ have not been traced back further than the Jurassic rocks.

207. The order given by Bower for the Filicales* is (excluding families which do not occur in our area): 1. *Ophioglossaceæ;* 2. *Marattiaceæ;* 3. *Osmundaceæ;* 4. *Schizeaceæ;* 5. *Gleicheniaceæ;* 6. *Cyatheaceæ;* 7. *Polypodiaceæ.*

208. Turning to the relative position of the orders within the Angiosperms, geological evidence throws no light on the relative antiquity of the several groups. Dr. Scott remarks that the fossil history of the Angiosperms shows no signs of a beginning. The appearance of the most widely separated groups is said to be sudden and simultaneous, and what are universally believed to be younger groups occur in the same beds with what are believed to be primitive. Even *Gamopetalæ*, and actually the *Caprifoliaceæ* (Viburnum), are,

* Bower, *The Ferns* (*Filicales*). Only Vol. I is published, but the author gives a tentative arrangement on p. 58, and this is practically the same as in his previous paper in *Phil. Trans.*, vol. 192, B (1899), and *The Origin of a Land Flora*, p. 653.

if leaf diagnosis can be relied upon (which, however, is very doubtful), found as far back as the Cretaceous period! Highly evolved *Apetalæ*, like *Artocarpus* (in this case with both leaf and fruit), highly evolved Monocotyledons, like the reeds, as well as palms, arborescent *Liliaceæ*, etc., have all been found as far back as the upper Cretaceous. By the upper Cretaceous epoch the Angiosperms were already dominant! Before the lower Cretaceous they do not exist so far as the geological record at present has yielded up its history! No light is thrown even on the relative ages of Monocotyledons and Dicotyledons. The Monocotyledons are placed first in many arrangements, but it would appear to be the Dicotyledons which are nearer to the common stock of Angiosperms and Gymnosperms.

209. The wood of the Dicotyledons exhibits in its general structure and arrangement of the secondary wood a very strong resemblance to that of the Gymnosperms. The main difference is in the general absence of true vessels in the Gymnosperms, but these do occur in the *Gnetaceæ*, and it is of special significance that the wood of a few *Magnoliaceæ* consists entirely of tracheids with bordered pits as in most Gymnosperms. The leaves of *Gnetum* are very dicotyledonous in appearance, though in the continuous plate-like medullary rays of their vascular bundles are also gymnospermous in character.

210. The inflorescence and flowers of the *Gnetales* are very different to that of most Gymnosperms, and appear to partake of the character of some groups of Dicotyledons classed by Engler as primitive.

211. In *Gnetum scandens* (p. **1232**) the integument (or inner integument of the nucellus, if there are two, see below) is prolonged into a very slender 3-toothed tube which makes it appear as the style and 3-lobed stigma of a closely investing ovary of a single ovule. This is surrounded by two tubular sacs of doubtful morphology, the inner being regarded sometimes as a second (outer) integument, and the outer sac as a rudimentary perianth which is not unlike the perianth of the female flower of some *Urticaceæ*. The male flower consists of a column terminating in two anthers and is surrounded by a single angular tubular sac or perianth. Both male and female flowers are whorled in the axils of annular bracts on panicled spikes.

The flowers are mixed with numerous cellular hyaline hairs, and the spikes with their numerous simple flowers remind one strongly of the catkins or spikes of some *Amentiferæ*, *Piperaceæ* or *Chloranthaceæ*, but the resemblance is perhaps merely superficial. We might consider the second integument as an ovary open at the apex, but then the style-like organ should be borne on this ovary, whereas it is merely a pollen-chamber, such as is found in other Gymnosperms formed from the integument, but much produced. It is, however, just conceivable that the neck of the outer integument or of one of the outer sacs, by growing up similarly to that of the inner integument and gradually absorbing its function, *may* have been a mode of origin of some ovaries. One or both these outer sacs may be a single sporophyll or connate sporophylls, as there is evidently a tendency in the genus for cataphyllary leaves to become connate, as is seen in the annular bracts.

The *Gnetales* no doubt had an origin very far down the Gymnospermous line.

212. There are other Angiospermous characters in *Gnetum*, *viz.* the reduction of the archegonia to free cells and the 2-cotyledonous embryo, and according to Seward, "it is in the *Gnetales* more than in any other Gymnosperms that we find features which help us to obtain a dim prospect of the lines along which Angiosperms may have been evolved."

213. If this be true, then the commencement of the Dicotyledons with such families as *Piperaceæ*, *Casuarinaceæ* and *Amentiferæ*, as is done by Engler, receives strong justification. *Casuarina* has several embryo sacs, and the ovule is orthotropous, *Juglandaceæ* has a single orthotropous ovule with only one integument, *Piperaceæ* has a single orthotropous ovule and its vascular bundles are in one or more rows. *Gnetum scandens* has alternating zones of wood and bast, reminding one of the structure in *Dalbergia paniculata*. Before leaving *Gnetum* it should be noted that the very long micropyle is surpassed in some palæozoic Pteridosperms, *e. g. Trigonocarpus* (probably the seed of an *Alethopteris*, which, in its turn, was the foliage of a *Medullosa* stem).

214. There are, however, striking analogies, if they are not more, between another group of the Angiosperms and more primitive Gymnosperms. Among the most interesting of the mesozoic fossils are the large group of *Cycadophyta* known as the *Cycadeoids*, first met with (in descending order) in the Cretaceous, and overlapping the appearance of the Angiosperms. Scott says that they may be called a dominant race as far back as the Trias, but below that their remains are scanty. They are divided into two tribes, the *Bennettiteæ* and the *Williamsonieæ*. In outward appearance the *Bennettiteæ* were like stumpy cycads (the crows' nests of the Isle of Purbeck belonged to them). At the risk of repetition* Scott's very fascinating account of the flowers of the *Bennettiteæ* may again be well reproduced :—

"The center is occupied by the gynæceum, seated on the convex receptacle, and consisting of numerous long-stalked ovules, imbedded among the interseminal scales. Surrounding this central body is the hypogynous whorl of stamens, fused below to form a tube, and expanding above into the pinnate sporophylls, bearing very numerous compound pollen sacs or synangia, filled with pollen. The whole is surrounded by an envelope of spirally arranged bracts, springing from the upper part of the peduncle. The general arrangement of parts is manifestly just the same as in a typical angiospermous flower, with a central pistil, hypogynous stamens, and a perianth. The resemblance is still further emphasized by the fact, long known, that the interseminal scales are confluent at their outer ends, to form a kind of pericarp or ovary wall. When to these general features we add the practically exalbuminous character of the seed, with its highly organized, dicotyledonous embryo, the indications of affinity with the higher flowering plants become extremely significant. The comparison was drawn by Dr. Wieland in 1901, immediately on his

* This was reproduced in my *Forest Flora of Chota Nagpur*, p. 44. The original was published in the *Journal of the Microscopic Society*, April, 1907, p. 139.

discovery of the hermaphrodite flower. . . . The flower, with its great stamens 10 cm. long in some species, must have been a striking object when it opened. As, of course, we can know nothing of the coloration of the perianth and other parts, we cannot tell how brilliant its appearance may have been; the bright tints of the carpels and ovules in some recent cycads suggests the probability that the attraction of colour was not wanting to the more elaborate flowers of the older *Cycadophyta*."

215. In this case, again, there is difficulty in tracing any homology between the sphorophylls of the gynæceum and the carpels of an Angiospermous ovary. The sporophylls are apparently the stalks of the ovules which thus each bear but a single terminal macrosporangium. However, it again has to be remembered how very imperfect is the material; how, of the many millions of plants existing in the mesozoic epoch, but a few score are known, and it seems quite possible that other groups of allied *Cycadophyta* existed at that time with quite differently constructed gynæcium. As to the rest of the flower, it seems reasonable to read into it a real homology with some of the large-flowered Angiosperms, and as the gynæcium is at least apocarpous, there is an extraordinary similarity between such *Bennettitean* flowers, and such as one would expect in an early type of flower among the *Ranales*, especially the *Magnoliaceæ*.

216. In a most interesting paper on the origin of the Angiosperms by Newell Arber and John Parkin, the *Nymphæaceæ*, *Magnoliaceæ* and other polycarpicæ among Dicotyledons, *Alismaceæ*, *Butomaceæ*, and *Palmaceæ* among Monocotyledons are taken as exhibiting many primitive features, while the *Piperales*, *Amentiferæ*, *Araceæ*, etc., with very simple flowers, are regarded as derived from phyla with more complicated ones by a process of reduction. The dicotyledons generally exhibit such a network of cross alliances that it is almost impossible, if more than one origin is ascribed to them, *e. g.* partly from a stock resembling the *Bennetiteæ*, or the more generalized *Williamsonieæ*, and partly from a stock allied to the *Gnetales*, to separate in many cases the derivatives of one stock from the other. One fact especially appears to me to be in favour of the theory of the Englerian view of the relative primitiveness of the *Casuarinaceæ*, *Juglandaceæ*, etc., and on the other hand, to militate against the position here assigned to the *Ranales*, is the existence in the former of single erect orthotropous ovules, and in the latter of anatropous or amphitropous ovules. The last are evidently a much more recent type.

217. On the whole, if the Angiosperms are derived from a single stock, the view taken by Arber & Parkin appears to meet most of the facts, and Scott states that "it is interesting to note that Arber & Parkin's hypothetical reconstruction of the flower of a hemi-angiosperm agrees almost exactly as regards the structure of the stamens, with the subsequently discovered *Williamsonia mexicana* of Wieland. . . . That there are striking analogies between the Angiosperms and the *Cycadeoids* is undeniable. It is also true that the analogies become accentuated if we take into consideration the older and more

generalized *Williamsonians* rather than the more specialized *Bennettiteans*. But, after all, a wide gap remains. We cannot be certain that there is anything more than parallel development. . . . But it may be that a real affinity exists, that the *Cycadeoids* and the Angiosperms are branches of a common stock."

This is the view taken in the following synopsis, which starts with the *Ranales*.

218. The arrangement, however, adopted for the Dicotyledons in the body of the Flora is, with a few exceptions,* that of Bentham & Hooker in the *Genera Plantarum*, which, in its turn, is based on that of A. P. de Candolle. This is the arrangement used in most English herbaria, and most English systematic works on the flowering plants. For that reason English field botanists find it convenient for new floras to follow the same sequence. But although the arrangement of the *Genera Plantarum* also begins with the *Ranales*, or rather part of the *Ranales*, there are several objections to the system as a natural arrangement, the chief of which is the artificial group of the *Apetalæ*. Petals may be present or not in the same species, and, although exceptions occur to the characters of groups in any arrangement, the apetalous division undoubtedly separates entirely nearly allied families. Moreover in many other instances the arrangement does not apparently profess to be phylogenetic. It if were, specialized families like the *Papilionaceæ* should not be treated before their more generalized allies, like the *Mimosaceæ*. The arrangement of the *Genera Plantarum* even put the Gymnosperms between the Dicotyledons and Monocotyledons.

219. The more modern and most serious competitor to the Hookerian system at present in the field is that German system of Endlicher, adopted more or less closely by Engler in *Die Naturlichen Pflanzenfamilien*, and by Strasburger, Warming and other European botanists. This is supposed to be phylogenetic (as far as a linear system can be), but Engler begins the Angiosperms with the Monocotyledons, and Dicotyledons with Peppers, *Amentiferæ*, etc., which he believed to be primitive, whereas, as discussed above, other botanists consider that the apparent simplicity of their flowers is a derived character. Moreover Engler begins the Angiosperms with the Monocotyledons, whereas it appears that if the *Cycadophyta* are somewhere near the line of origin, the Dicotyledons are the more primitive type. In the following synopsis of Angiospermous families therefore the arrangement starts with the *Ranales*.

220. Unfortunately there is no systematic work at present published which commences the phylogenetic arrangement of the Angiosperms with the *Ranales*. Recently Mr. Hutchinson has taken up such a classification in the *Kew Bulletin* (see Nos. 2 and 7 of 1923, and 2 of 1924), and I should have reproduced it here in place of the present synopsis, but his groups are not at present sufficiently defined, and it seems to me that the adoption of the two main parallel phyla

* *E. g.*, the *Euphorbiaceæ*, in view of the frequent presence of petals, are treated in the *Thalamifloreæ*, the *Samydaceæ* are combined with the *Flacourtiaceæ*, the *Ficoideæ* or *Aizoaceæ* are placed near their allies, the *Portulacaceæ*.

a woody one and a herbaceous one, is unsatisfactory. At present, also, the classification is not in a form likely to help the field botanist. I have, therefore, fallen back in the main on the classification adopted in my *Flora of Chota Nagpur*, which I am glad to see in many respects corresponds with that of Mr. Hutchinson. But that classification which was carried into the body of the Flora attempted to conserve, for the convenience of those who know the Hookerian system, more of that system than now seems necessary for a mere conspectus of families. I have therefore further modified it, and where possible have adopted many of the views of Mr. Hutchinson.

221. The Monocotyledons follow the Dicotyledons, and there seems little doubt that their nearest allies among the Dicotyledons is to be found in the *Ranales*, although some botanists here, again, treat the points of resemblance as parallel developments.* If there be an affinity, as I believe, it is natural to commence the Monocotyledons with the families which best show it, viz. the apocarpous *Alismaceæ* and their allies. Erect orthotropous ovules are very rare in Monocotyledons (*e.g.* some *Araceæ*).

CONSPECTUS OF ORDERS AND FAMILIES.

222. The vegetable kingdom may be divided into five† main divisions, viz. *Mycetozoa, Thallophyta, Bryophyta, Pteridophyta,* and *Phanerogamia*. Included in the large division of the *Thallophyta* are the fungi, a group of importance to the forester, but not sufficient is known of the fungi of Bihar and Orissa to deal with them. The Bryophyta include the mosses and liverworts—a group, so far as is known, of little importance in our area. The descriptions are therefore limited to the *Pteridophyta* or Vascular Cryptogams (Ferns and Fern allies) and to the Phanerogams (Flowering or Seed Plants).

223. **I. PTERIDOPHYTA** (pp. 86–88).

Distinct alternation of sexual and asexual generations. Sexual generation represented by a small thalloid expansion (prothallium), rarely tuberous, without differentiation into stem and leaves, occasionally not even becoming free of the spore. It bears archegonia and antheridia on the same or different individuals, and after fertilization of the oosphere of the archegonium (which then becomes an "oospore") gives rise by repeated segmentation of the oospore to the embryonic asexual plant. The asexual generation becomes well developed and relatively large (it is the Fern, Club Moss, Horsetail, etc., as popularly known), and is usually clearly differentiated into stem or rhizome, leaves and roots, and has an internal vascular system. It bears spores

* This is the view of Rendle, who states "the resemblance cannot be regarded as indicating any affinity. It is rather a coincidence." (*Classification of Flowering Plants*, i, p. 213.)

† Some biologists would add, and start with, a sixth main division, the *Schizomycetes*, which include the well-known bacteria or bacilli. The position of the *Mycetozoa* in the vegetable kingdom is sometimes disputed. They appear to be derived from naked amœbæ.

inside "sporangia" situated on the back of or on the margin or at the base of leaves or modified leaves (sporophylls). These spores may be all similar (homosporous), or they may be of two kinds—macrospores (or megaspores), which only produce female prothallia (*i.e.* prothallia bearing archegonia, but not antheridia), and microspores, which only produce male prothallia (*i. e.* prothallia bearing antheridia only). The *Pteridophyta* are divided into 3 principal classes (*vide* p. 80), viz.:

1. Leaves simple, close, and small relatively to the axis. Sporangia at the base of the small sporophylls which are grouped into a terminal spike, p. 86........................1. *Lycopodineæ.*
2. Leaves minute, whorled, reduced to teeth and connate below into a sheath, sporangia borne on the underside of modified peltate sporophylls or sporangiophores, which form a cone-like termination to the stem or shoots, p. 86..........2. *Equisetineæ.*
3. Leaves large relatively to the axis and usually compound. Sporangia on the margins or backs of the leaves or modified leaves or in sporocarps at base of the leaves, p. 87......3. *Filicineæ.*

CLASS I.—LYCOPODINEÆ.

224. Order I. LYCOPODIALES. Selaginellas and Club Mosses. (Only one existing order.)

Sporophyte with simple or usually 2-chotomously branched stem and small crowded simple leaves. Sporangia solitary at the base of the leaves or in their axils, arising from a group of cells. Sporophylls similar to the barren leaves or dissimilar and always at the summit of the stem or its branches, the growth of which they terminate. The aggregate of sporophylls may be called a "flower." Spores similar, producing monœcious prothallia, or dissimilar (macrospores and microspores). The macrospores produce prothallia which bear archegonia only, and never become free of the spore, and though not as much reduced as in the Phanerogamia, are only sufficiently exposed through a fissure in the spore for the archegonia to become fertilized by the antherozoids (or spermatozoids) of the male prothallium. The microspores form a prothallium which completely fills the spore, and the mother-cells of the spermatozoids are produced from certain of its cells representing rudimentary antheridia.

Isosporous. Leaves multifarious without ligule
Fam. *Lycopodiaceæ* (p. 1220).

Heterosporous. Leaves often 4-farious and differing in shape and size, with a microscopic ligule.......Fam. *Selaginellaceæ* (p. 1222).

CLASS II.—EQUISETINEÆ.

225. Order I. EQUISETALES. Horse-tails. (Only one existing order.)

Sporophyte (asexual generation) with rhizome and usually a copiously branched* stem with articulate internodes and whorls of very small tooth-like leaves. Branches usually whorled. Sporangia arise as pluricellular protuberances on the underside of peltate

* Fertile (cone-bearing) stems are often unbranched, while the barren ones of the same species may be branched. In our species both are branched.

sporophylls which are arranged in a cone-like terminal spike or flower, 5-10 sporangia on the underside of each sporophyll. Spores (in existing genera) of one kind only producing well-developed, usually diœcious independent prothallia........Fam. *Equisetaceæ* (p. **1219**).

CLASS III.—FILICINEÆ.

226. Leaves well developed relatively to the stem, often very large and compound, alternate, circinate in vernation (except in *Salviniaceæ* and *Ophioglossaceæ*). Sporangia on the margins or backs of the leaves, which either resemble the barren ones or are specially modified, rarely (*Hydropterideæ*) the sporangia grouped inside sporocarps formed of leaf segments so much modified as to appear as special non-foliar organs at the bases of the leaves. Fertile leaves not confined to a definite part of the shoot and not determining its growth (exc. *Ophioglossaceæ*).

A. HOMOSPOROUS FILICINEÆ. The Ferns.

Spores of one kind only, in sporangia which are not included in sporocarps (though sometimes grouped into synangia) and are borne on evident leaves or on segments of leaves modified into sporangiophores.

1. *Eusporangiate Ferns.*

The sporangia arise from a group of cells. Either very large ferns with stipules and grouped sori, or small ferns with usually a single annual leaf dividing into a barren foliaceous part and an inflorescence-like sporangiophore.

a. Order I. MARATTIALES.
Very large ferns with stipular appendages at base of fronds. Sori grouped, or sporangia connate and sori formed into chambered synangia. Annulus 0 or apical and rudimentary.
Fam. *Marattiaceæ* (p. **1212**).

b. Order II. OPHIOGLOSSALES.
Small ferns without stipules. Rhizome very short, subterranean. Leaf usually solitary and dividing into a barren foliaceous part and an inflorescence-like spore-producing spike or panicle with large marginal 2-valved sporangia without annulus, sometimes sunk in the tissue........................Fam. *Ophioglossaceæ* (p. **1213**).

2. *Leptosporangiate Ferns.*

Order III. POLYPODIALES.
The sporangia arise from a single epidermal cell (archesporium) and are usually collected into small groups (sori), but the individual sporangia are always free and the sori are not united into regular

groups or chambered synangia. Stipules never present. Fertile part of frond similar to the barren, or if dissimilar then fronds several. Sporangia usually situated on the veins, not sunk in the mesophyll, sorus often surrounded by or roofed over by an indusium. Annulus usually present (consisting of a single row of cells or disciform).

a. Sporangia sessile, often few in the sori or not in definite sori. Indusium 0 or a continuation of the leaf margin. Annulus 0 or incomplete, or if complete, transverse or disciform (vertical and complete in some *Parkeriaceæ*).

i. Sporangia not in regular sori, in our species solitary in the axils of large imbricating involucres, which are arranged in a spiciform manner 2-seriatim on the lobes of the leaf segments. Annulus disciform or coronate, apical. Frond of indefinite growth, scandent (in our species)
Fam. *Schizeaceæ* (p. **1211**).

ii. Sporangia very few in the sori, dorsal, without indusium. Annulus equatorial or oblique. Rhizome widely creeping. Fronds 2-chotomous of indefinite growth.
Fam. *Gleicheniaceæ* (p. **1210**).

iii. Sporangia not in sori, arising in acropetal succession in parallel rows and covered by the revolute leaf margin. Marsh ferns with dimorphic fronds..Fam. *Parkeriaceæ* (p. **1210**).*

b. Sporangia stalked, in well-marked sori or continuous rows, with complete oblique or vertical annulus. Indusium present or absent.

Tree ferns. Sporangia opening more or less transversely with complete oblique annulus, stalk short. Sorus naked or surrounded by a cupular involucre................Fam. *Cyatheaceæ* (p. **1183**).

Dwarf ferns. Sporangia very numerous in the sori, with a vertical incomplete annulus, stalk uusally long. Indusium present or absent, membranous when present, rarely herbaceous.†
Fam. *Polypodiaceæ* (p. **1183**).

B. HETEROSPOROUS FILICINEÆ.

Order IV.—HYDROPTERIDEÆ. Water ferns.

Floating or marsh plants. Leptosporangiate. Sporangia contained in capsules or sporocarps derived from much modified leaf segments, arising from the shoot at the base of the foliage leaves or on a pedicel springing from the petiole. Spores of two kinds, microspores and macrospores. Prothallia often rudimentary and remaining attached to the spore.

Annual floating aquatics with simple leaves.
Fam. *Salviniaceæ* (p. **1216**).

Marsh plants with creeping rhizome and erect long-petioled 4-foliolate leaves.......................Fam. *Marsiliaceæ* (p. **1217**).

* Probably a very primitive family.
† In this large family the groups with the sori marginal are probably the more primitive. See note on p. 77 on phyletic drift.

227. **II. PHANEROGAMIA or SPERMOPHYTA.**

(The Flowering or Seed Plants.)

The alternation of sexual and asexual generations is concealed in the formation of the ovule and seed. A "seed" is formed when the ripe macrospore is not liberated from the macrosporangium but remains enclosed in it and there produces rudimentary prothallium, archegonia or rudimentary archegonium, and finally an embryo of the next asexual generation which appears to be sexual from its containing and becoming amalgamated with the sexual generation. The prothallium (which in the *Selaginellaceæ* also does not become free of the spore) remains entirely in the macrospore, now termed the "embryo-sac." Usually only one embryo-sac is formed in each macrosporangium or "ovule." This ovule consists of one or two integuments enclosing a central small-celled tissue, the "nucellus," in which the *embryo-sac* arises. After fertilization of the oosphere in the embryo-sac the ovule undergoes changes resulting in the ripe seed, which consists of at least three parts—the seed-coat or testa, the endosperm (unless this has been consumed by the growing embryo), and the embryo itself. The endosperm is a tissue in the embryo-sac which represents the prothallium in the Gymnosperms. In the Angiosperms the prothallium and its archegonium with oosphere are represented by a few cells only and the endosperm or albumen is not formed until after fertilization, when it is apparently derived from the growth and division of the nucleus of the embryo-sac and not from the prothallial cells. The microspores of the Phanerogams are called "pollen-grains," which, instead of motile spermatozoids, develop a "pollen-tube," the contents of which reach the ovule by transportation of the whole pollen-grain by means of wind, insects, etc.

228. The seed-bearing plants or Phanerogams are divided into two sub-divisions :—

A. Ovules before fertilization not enclosed in an ovary formed by the cohesion of the female sporophylls or carpels. Endosperm or prothallium developed before pollination and developing archegonia. Cotyledons 2–many. Flowers always 1-sexual........................I. GYMNOSPERMÆ (p. 89).

B. Ovules produced inside an ovary formed of the cohering carpels or of one carpel with coherent margins and having at the summit the stigma on which the pollen-grains germinate. Endosperm not homologous with the prothallium but developed after pollination together with the embryo. Cotyledons 1–2..................II. ANGIOSPERMÆ (p. 90).

229. **SUB-DIVISION I. GYMNOSPERMÆ.**

(*See above.*)

A. Stems rarely branched and then very sparingly. Leaves very large, pinnate and fern-like, but coriaceous. Flowers diœcious. naked, cone-like.......................Class I. CYCADINEÆ.

Exceptions:—

The carpels of *Cycas* are arranged round the main axis and not in evident cones.

Only one existing family............Fam. 1. *Cycadaceæ* (p. 1227).

B. Stems copiously monopodially branched. Leaves small, simple, acicular or scale-like, rarely lanceolate or ovate. Flowers mostly cone-like, naked. Ovules usually basal on the sporophylls..........................Class II. CONIFERÆ. This embraces several orders and families poorly represented in our area and therefore treated as one family.
Fam. 2. *Coniferæ* (p. 1229).

C. Habit various. Leaves opposite. In our species broad-leaved climbers with the male and female sporophylls in whorls on a spike with annular bracts. Around the erect ovule and outside its one or two integuments is an investing covering open at the top, which is variously regarded as an open ovary or a fused perianth (see p. 81).............Class III. GNETINEÆ. Only one family...............Fam. 3. *Gnetaceæ* (p. 1234).

230. SUB-DIVISION II. ANGIOSPERMÆ.

(See p. 89.)

Plants of very various habit. Flowers 1–2-sexual, usually furnished with a perianth. Carpels or female sporphylls infolded so that the edges unite or several carpels in one whorl united to one another, in both cases to form a one- or more-celled closed chamber or "ovary." Ovules enclosed in the ovary so that the pollen-grains are unable to come directly into contact with the ovule, and fertilization is effected by the pollen-tubes growing through a special conducting tissue of the carpel, which is often prolonged into a "style" bearing the "stigma" or organ for reception of the pollen-grains (if the style is absent the *stigma* is sessile; each carpel forms a stigma, but these may become connate into one). Macrospore (embryo-sac) before fertilization or pollination contains nuclei, but no distinct prothallial tissue or recognizable archegonia. The endosperm is formed after fertilization. The Angiosperms contain two classes:—

A. Plants of which the embryo has *two seed leaves* or cotyledons. These often expand as the first green leaves of the plant (epigeal germination) as in the mustard, bean, castor oil, *Grewia*, *Gmelina*, etc., or they remain in the seed (hypogeal germination), and are then usually very thick, *e. g.* the Mohwa tree (*Bassia*), etc. Rarely there are 3 cotyledons, *e. g.* *Terminalia arjuna* in some cases, *Cansjera* (*f.* Griffiths), and exceptionally in many other plants. Exceptionally the cotyledons remain undifferentiated, *e. g.* *Loranthus* spp.
Class I. DICOTYLEDONES (p. 91).

B. Plants of which the embryo has only one cotyledon or seed leaf, which may become free from the seed and forms the first green leaf, *e. g.* *Agave*, or remains with its tip entirely or partially enclosed in the seed from which it absorbs the

endosperm or albumen, *e.g. Dioscorea*, Palms, Grasses, etc. Embryo sometimes undifferentiated, *e.g. Orchidaceæ*.

Class II. MONOCOTYLEDONES (p. 145).

The fact that the number of cotyledons is correlated with a number of other characters which render it usually easy to distinguish a Dicotyledon from a Monocotyledon shows that these two classes are natural.

231. Class I. DICOTYLEDONES.

The Dicotyledons comprise the great majority of flowering plants and practically all our forest trees. They usually have the venation of the leaf reticulate or much branched. Externally the arborescent forms are easily distinguished from the arboreous monocotyledons by the relatively copious branching of the stem. Anatomically the stem is generally well distinguished by the vascular bundles being in a ring and, on secondary growth in thickness taking place, from the woody tissue uniting outside the pith into a solid cylinder enclosed by a distinct cylinder of bark. In between the two is a very thin tissue, the "cambium," which continually adds more wood to the inner cylinder. The flowers of dicotyledons when not reduced usually have their parts in 4's or 5's or sometines 2's, but 3's are common among the *Ranales* and in a few other families. The leaves are petioled or sessile, but rarely have a long sheathing base as is so common in the Monocotyledons.

232. The following is the division of the Dicotyledons according to the *Genera Plantarum* of Bentham & Hooker (*vide* p. 84), and in accordance with which work (with few exceptions) the sequence of the families in the body of this flora is arranged:—

I. *Polypetalæ.*—Flowers dichlamydeous. Petals free* :—

SERIES A : *Thalamifloræ.**—Calyx usually free from the ovary. Petals 1–2- or many-seriate. Stamens many or definite, inserted on the torus or receptacle, which is usually small or elongate or with a short gonophore. Ovary superior. Families **1** to **28** (exc. **19**).

SERIES B : *Discifloræ.**—Calyx mostly free from the ovary. Petals 1-seriate. Stamens usually definite, inserted on a more or less swollen or broadened part of the receptacle known as a "disc." Ovary usually superior or immersed in the disc..Families **31** to **51**.

SERIES C : *Calycifloræ.**—"Calyx-tube" (really an elongation of the outer zone of the torus and here usually referred to as the hypanthium) more or less investing or adnate to the ovary, petals 1-seriate inserted on the calyx-tube (hypanthium). Stamens many or definite, usually inserted on a disc lining the calyx-tube. Ovary usually included in the calyx-tube, or inferior. Part Fam. **14**, Fam. **19**, Fam. **30**, and Families **52** to **76**.

II. *Gamopetalæ.**—Petals more or less combined into a lobed corolla, pistil never apocarpous, or if carpels distinct, then styles united and carpels only 2. The calyx is very frequently gamosepalous below, and often persistent. Petals or corolla-lobes in a single series and usually 4 or 5 (see exceptions), or corolla 2-lipped. Stamens usually isostemonous, or fewer, often adnate to the corolla-tube. Carpels as many as the petals or very often reduced in number. Leaves rarely compound.

This group, which also is not quite natural, being derived from several distinct groups of *Choripetalæ*, is adopted in the following synopsis of families (p. 132) as being generally easily recognizable. Families **77** to **106**.

* Exceptions omitted.

III. *Monochlamydeæ* or *Apetalæ*.—Perianth simple with the lobes or segments similar to one another and usually calycine, sometimes minute or altogether wanting..............................Families 107 to 128.
(To this group also belong the *Euphorbiaceæ*, Fam. 29.)

The following is the more phylogenetic arrangement referred to on p. 85.

233. Series I. CHORIPETALÆ (pp. 97–131).

Flowers when dichlamydeous without the corolla being produced at the base into a petaloid tube, or if corolla somewhat tubular at the base from the connate petals then stamens not reduced to 4 together with a reduction of the carpels to 2, and ovules with 2 integuments. Corolla often 0.

See also a few polypetalous genera in the *Gamopetalæ*, viz. *Embelia* (*Myrsinaceæ*), *Symplocos* (*Styraceæ*), *Azima* (*Salvadoraceæ*), *Olea* and *Linociera* (*Oleaceæ*), and a few apetalous genera in the *Gamopetalæ* (p. 132).

Exceptions to *Choripetalæ* :—

Corolla gamopetalous in some *Mimosaceæ*, *Crassulaceæ*, *Caricaceæ*, *Cucurbitaceæ* and *Ilicaceæ*. Petals sometimes connate at the base in *Cissampelos* (connate into a 4-lobed cup), *Tamarix*, *Pittosporum*, *Malvaceæ* (connate and adnate with the staminal tube), *Rutaceæ* (adnate with the staminal tube), *Meliaceæ*, *Cansjera*, loosely connate in *Olax* and *Alangioideæ*.

Hypanthium sometimes coloured and tubular, and simulating a gamopetalous corolla in *Woodfordia*, *Loranthus*, also in *Nyctaginaceæ* and others in which there is only one perianth whorl.

234. CONSPECTUS OF THE CHORIPETALOUS GROUPS.

I. Flowers mostly hypogynous; acyclic, hemicyclic or cyclic. If perigynous or epigynous then 3-merous mostly 3-merous or hemicyclic or with parietal placentation. Disc 0. Stamens often many or 3-merous or anthers opening by valves. Ovary apocarpous or 1-celled, or if syncarpous and several-celled ovules many and parietal or, if few, stamens or carpels 3 or many, or ovules campylotropous. Seeds usually albuminous with small or curved embryo. Leaves simple.

Exceptions :—

The *Aristolochiaceæ* have flowers epigynous mostly 3-merous, but in our genus the perianth is oblique and entire. Fls. epigynous in *Hernandiaceæ*, but anthers opening by valves.

Fls. perigynous and disc present in *Moringa*, but ovary 3-merous with parietal placentation. Its affinities are, however, very doubtful, and it has compound leaves. Fls. epigynous in *Opuntiales* but acyclic.

Flowers epigynous in *Begoniaceæ* and *Cucurbitaceæ*. The flowers are 1-sexual. The female has usually 3 parietal placentæ, which may, however, meet in axis or in some *Begoniaceæ* placentæ sub-basal.

Disc sometimes well developed in *Capparidaceæ* and in *Passifloraceæ* with ovary on a gynophore and placentation parietal. A crenate disc occurs in *Tamarix* which has a 3-carpellary 1-celled ovary with sub-parietal placentation, but the position of *Tamaricaceæ* is very doubtful. Disc often present in *Passifloraceæ* with ovary on gynophore, 1-celled with parietal placentæ. A fleshy disc is present in some *Guttiferaceæ*. A disc of glands or scales occurs also in *Flacourtiaceæ*.

Ovule 1 orthotropous in *Polygonales*. Ovules 1–2 axile in each cell and stamens neither 3 nor many in a few *Malvales* and *Euphorbiales*.

Leaves often pinnate in *Clematis* (*Ranunculaceæ*), dissected in *Fumariaceæ*,

rarely pinnate in *Cruciferæ*, digitate in some *Capparidaceæ*, *Bixaceæ*, a few *Malvaceæ* (*Bombaceæ*) and *Sterculia*, few *Cucurbitaceæ*, also in very few *Euphorbiaceæ* (*Manihot*, *Bischofia*; while several *Phyllantheæ* have branchlets simulating pinnate leaves).

Leaves are 2–3-pinnate in the anomalous family *Moringaceæ*.

A. Flowers acyclic or hemicyclic or ovary apocarpous and stamens indefinite, or anthers opening by recurved valves, or flowers in general 3-merous or $n \times$ 3-merous.* Flowers dichlamydeous or sepals passing into petals or petaloid, more rarely haplo-homoiochlamydeous, then often perianth in two 3-merous whorls. Leaves often glandular and aromatic.

Orders: I. *Ranales* (p. 97); II. *Aristolochiales* (p. 100); III. *Opuntiales* (p. 100). See also *Podostemonaceæ* and *Saxifragaceæ*.

B. Flowers cyclic and ovary syncarpous. Stamens definite or indefinite, anthers never opening by valves and flowers not 3-merous except often in the gynæceum.

Exceptions :—

Perianth sometimes 3-merous in *Argemone*, which has all the other characters of *Parietales*. Ovary apocarpous with whorled carpels in some *Phytolaccaceæ*.

1. Ovule only 1 in the ovary or several on a free central placenta, or if ovary partially 2-5–celled from the base then ovules amphitropous or campylotropous, rarely ovule 1 orthotropous. Flowers regular, usually monochlamydeous, stamens definite and epitepalous, rarely indefinite. Stipules usually scarious. Embryo usually curved.

Note.—The ovary may be monocarpellary in some *Nyctaginaceæ*, and in many of the families is apparently 3–2-carpellary (with a single ovule).

Orders: IV. *Caryophyllales* (p. 101); V. *Polygonales* (p. 103). See also some X. *Urticales* (part).

Exceptions :—

Stamens indefinite in some *Nyctaginaceæ* and some *Portulaca*.
Ovary 1-many-celled in *Aizoaceæ*.
Carpels whorled in *Phytolaccaceæ* with 1 ovule in each carpel.

2. Ovules more than 1, usually many in the ovary, parietal on 2 or more placentæ, more rarely axile, very rarely basal and erect in each cell of a several-celled ovary (*Guttiferaceæ*). Flowers dichlamydeous, often $n \times$ 2-merous, usually regular. Stamens many or definite. Leaves penninerved.

Orders: VI. *Theales* (p. 104); VII. *Parietales* (p. 106).

Exceptions :—

Flowers monochlamydeous in a few *Flacourtiaceæ*, irregular in *Fumariaceæ*, *Violaceæ* and *Moringaceæ*. Leaves palminerved or digitate in some *Capparidaceæ* and *Bixaceæ*. Ovules 2 collateral pendulous in each cell in *Shorea*, in which respect it approaches *Malvales* (*Tiliaceæ*).

3. Ovules axile or from the inner angles 1–2 or 2-several in each cell of a several-, frequently 3-celled ovary which is frequently 3-lobed or 2–many-coccous, or capsular with 3–5 valves in fruit. Stamens often many, rarely definite, often monadelphous at least at base, sometimes filaments entirely connate into a column. Leaves never

* n is usually 2.

pinnate, sometimes digitate, usually simple but palmilobed or palminerved. Hairs very often stellate. Sap often mucilaginous or milky.

a. Flowers mostly 2-chlamydeous and 2-sexual :—

Order VIII. *Malvales* (p. 110).

b. Flowers mostly monochlamydeous and 1-sexual :—

Order IX. *Euphorbiales* (p. 111).

Exceptions :—

Flowers reduced to single stipitate stamens or single 3-celled ovaries (in compound inflorescences) in some *Euphorbiales* and ovary sometimes reduced to 2 carpels (see other exceptions under the Orders).

Ovary 1-celled in *Waltheria* (*Sterculiaceæ*) and in *Antidesma* (*Euphorbiaceæ*). Flowers slightly zygomorphic in some *Sterculiaceæ*.

Fruit drupaceous in some *Tiliaceæ* and *Euphorbiaceæ* or sometimes sub-baccate in *Euphorbiaceæ*.

Ovary nearly apocarpous in a few *Sterculiaceæ* and separating into follicles in fruit.

4. Ovules 1–2 from near the base or 1–2-pendulous from near the apex of the 1-celled superior ovary or (*Salicales*) many parietal ascending. Flowers always much reduced and achlamydeous or monochlamydeous, often 1-sexual with stamens isostemonous and opposite the tepals (if any) or fewer.

Groups of doubtful affinity.

a. Monochlamydeous with epitepalous stamens or in some *Moraceæ* with the flowers enclosed in pseudocarps, the stamens reduced to 1 or few.

Order : X. *Urticales* (p. 112).

b. Achlamydeous or perianth (in *Casuarinaceæ*) perhaps represented by the 2 median scarious tepals or (in *Salicaceæ*) by a cupular or glandular disc.

Orders : XXIV. *Salicales* (p. 131) ; XXV. *Casuarinales* (p. 131).

II. Flowers hypogynous cyclic, never 3-merous, with a conspicuous variously shaped disc, or becoming perigynous or epigynous with reduction of one of the perianth whorls. Ovary syncarpous of 2–several carpels, cells with 1–2 ovules. Stamens diplostemonous or fewer. Leaves frequently pinnate or 1–3-foliolate or sometimes digitate. Ovary never on a gynophore (exc. *Proteaceæ*), but sometimes reduced to 1 cell and then ovules pendulous anatropous from an incomplete. axis, neither parietal nor on a free central placenta, if basal in the cells then anatropous, usually axile or pendulous.

Exceptions :—

Disc 0 in many *Elæagnales* and *Santalales*, in which the perianth is always submonochlamydeous or monochlamydeous or 0.

Disc of glands only in *Linaceæ* but fls. hypogynous, diplostemonous, ovary 3–5-celled with 1–2 axile ovules in each cell.

Disc obscure in *Malpighiaceæ* but stamens diplostemonous, fls. often irregular, ovary 3-celled with 1 axile ovule in each cell. Fruit of samaras.

Disc of glands or obscure in *Geraniaceæ* but leaves often compound, and torus raised between the lobes of the ovary.

Disc 0 in *Balsaminaceæ* and one whorl of stamens suppressed. Fruit a 3-valved capsule with valves elastically recoiling from the placentiferous axis and flowers irregular.

Disc 0 or confluent with the ovary in *Ilicaceæ.*
Ovules many in each cell in some *Biophytum* and *Averrhoa* (*Geraniaceæ*), and then leaves pinnate and stamens diplostemonous. Ovules many superposed in each cell in *Impatiens* but capsule with 5 elastically recoiling valves. Ovules many in each cell in *Swietenieæ* and *Cedreleæ* (*Meliaceæ*), but leaves pinnate and other characters normal. Ovules sometimes several in each cell in *Citrus*, *Ægle* and *Feronia* (*Rutaceæ*), but leaves 1-foliolate or pinnate and also gland-dotted.
Ovules sometimes amphitropous or campylotropous and embryo sometimes spiral in *Sapindaceæ*.
Our species of *Proteaceæ* (*Grevillea*) has not only the ovary on a stipes, but the ovules are amphitropous and laterally affixed. The affinities are doubtful.

A. Stamens diplostemonous (or obdiplostemonous) or by reduction fewer than diplostemonous but more than isostemonous and then often 8 and flowers often irregular. Leaves often pinnate or gland-dotted, and fruit often lobed or coccous.
Orders: XI. *Geraniales* (*Gruinales*) (p. 114); XII. *Sapindales* (p. 117).
Exceptions :—

Stamens and carpels often numerous in some *Ochnaceæ* and *Rutaceæ*, but disc conspicuous or ovary deeply lobed or leaves glandular. Stamens 12–15 in *Peganum* (*Zygophyllaceæ*) and ovules many in each cell, ovary deeply 2–3-lobed.
The epipetalous stamens are suppressed in *Impatiens*, the flowers are spurred as in many other *Geraniales*, and the capsule valves after dehiscence remain attached at the top to the axis. St. only 2–3 in the hermaph. flower of *Ailanthus*. Stamens sometimes only 1–2 perfect in *Anacardiaceæ* or isostemonous.

B. Stamens isostemonous or 3 only, rarely 2–3-times the number of the sepals and then flowers sub-monochlamydeous and ovary inferior. Disc often very pulvinate, occasionally tubular (*Leea*). Ovary 2–5-celled with 1–2 ovules in each cell, more rarely 1-celled with 1–2 basal or pendulous ovules. Leaves simple, rarely 1–2-pinnate or digitate (some *Ampelidaceæ* and most *Umbellales* and *Grevillea*).
Exceptions :—

Ovules sometimes 3 pendulous from an incomplete axis in some *Olax* or from a central column in *Santalaceæ*. Ovules 2–10 in each cell in *Hippocrataceæ*, 1 erect in each cell in *Rhamnaceæ*. Ovary 3–16-celled in *Ilex*, irregularly many-celled in *Siphonodon*.
Ovary 1-celled superior or half-inferior with 1 pendulous ovule from the top in *Opilia* (*Olacaceæ*); 1 ovule pendulous from a very short basal placenta in *Cansjera*, which has a gamopetalous corolla; 1-celled with 2 ovules pendulous from the top in *Natsiatum* (*Icacinaceæ*), a climber with palminerved leaves and valvate petals connate at the base and 2 linear diverging stigmas; 1-celled with a single basal anatropous ovule in *Elæagnus*. Ovary 1-celled with 2 collateral sub-apical amphitropous ovules in *Proteaceæ*. Leaves often pinnatifid or pinnate in *Proteaceæ*.
Perianth irregular coloured, ovary inferior, ovule and placenta not differentiated in *Loranthus*.

1. Calyx usually well developed, flowers dichlamydeous, ovary usually superior (inferior in few *Rhamnaceæ*), more than 1-celled.
Orders: XIII. *Celastrales* (p. 118); XIV. *Rhamnales* (p. 120).
2. Calyx scarcely or slightly developed, but tube or hypanthium sometimes accrescent in fruit (perianth 0 in female of *Balanophora*).
a. Ovary more than 1-celled, inferior:—
Order: XV. *Umbellales* (p. 121).

b. Ovary 1-celled, sometimes imperfectly 3-celled at base:—

i. Ovary superior in flower or half superior or inferior, flowers sometimes irregular.

Order: XVI. *Alangiales* (p. 121); XVII. *Olacales* (p. 122); XVIII. *Santalales* (p. 122).

3. Flowers haplochlamydeous, the calyx (probably) only represented and usually well developed, sometimes coloured and irregular. Stamens epitepalous. Ovary superior.

Orders: XIX. *Elæagnales* (p. 123); XX. *Proteales* (p. 124). (See also X. *Urticales*, p. 112).

III. Flowers dichlamydeous, perigynous or epigynous with the sepals, petals and stamens on the edge of the hypanthium which is often produced above the ovary or on a disc lining the hypanthium. Stamens diplostemonous to many. Ovary apocarpous to syncarpous; if apocarpous flowers cyclic not 3-merous and embryo large, if reduced to one carpel or if syncarpous and 1-celled then stamens 9–many and usually ovules many. Leaves simple or compound. ←— I.

Exceptions:—

Flowers nearly hypogynous in some *Leguminosæ* and *Rosales* and then leaves compound and embryo large. Fls. hypogynous in some *Podostemonaceæ*.

Flowers hypogynous in some *Droseraceæ* and ovules many on parietal placentæ, and the seeds have a small embryo. This family is therefore sometimes placed in the *Parietales*. Parietal ovules occur however also in the *Saxifragaceæ*, which the *Droseraceæ* more resemble in habit and inflorescence than any of the *Parietales*.

Petals are wanting in a few *Combretaceæ* and the ovules sometimes only 2, pendulous, these are trees or shrubs with opp. or sub-opp. leaves, diplostemonous stamens and large embryo. Petals are rudimentary or obsolete in a few *Ammannia* (*Lythraceæ*). Ovary is 3-merous or 3-celled in a few genera and whole flower is 3-merous in *Sonerilla*, but other characters are those of this group.

A. Stamens often more or less connate. Ovary apocarpous and often reduced to a single carpel, or if apparently syncarpous with the carpels separately adnate to the inside of the hypanthium or loosely connate or the styles free or carpels separating in fruit.

Orders: XXI. *Rosales* (p. 124); XXII. *Leguminosæ* (p. 127).

Exceptions:—

Corolla gamopetalous in some genera, especially in *Mimosaceæ*, see exceptions under *Choripetalæ*.

Carpels early connate in *Eriobotrya* and *Pyrus* (*Rosaceæ*), forming an inferior 2–5-celled ovary with styles connate, ovules 2 in each cell, but stamens many. Carpels 2 connate into a 1-celled ovary in *Vahlia* (*Saxifragaceæ*) with 2 pendulous placentæ and many ovules. The fruit dehisces apically between the styles into its constituent carpels. Stamens only 5.

Stamens isostemonous and nearly hypogynous and ovary nearly free 1–3-celled with distinct styles and 3–5-valved capsule in *Droseraceæ*.

Carpels connate in *Myriophyllum*, but separating into cocci in fruit.

Stamens fewer than diplostemonous, usually by abortion, in some *Cæsalpiniaceæ*, and then fruit a pod with several seeds with large embryo. Stamens isostemonous or diplostemonous in *Sonerilla* (*Melastomaceæ*) and *Lawsonia* (*Lythraceæ*), variable in number and often reduced in the marsh genus *Ammannia* (*Lythraceæ*), isostemonous in *Ludwigia* and *Trapa* (*Onagraceæ*, the last an aquatic).

B. Stamens free, rarely connate at base. Ovary syncarpous with connate styles. Albumen 0. Hypanthium often beaked above the ovary and then expanded into a calyx-tube. Leaves very often opposite.

Order: XXIII. *Myrtales* (p. 128).

235. DESCRIPTIONS OF ORDERS AND FAMILIES OF THE CHORIPETALÆ.

Order I. RANALES.

Flowers mostly regular and 2-sexual, *acyclic or hemicyclic*, or if cyclic then the whorls *mostly 3-merous*. Stamens hypogynous, *usually many*, or if definite often in 3-merous whorls or anthers opening by valves. *Gynœcium apocarpous*, carpels usually many, but sometimes reduced to one. Ovules anatropous or amphitropous. Seed with *copious albumen* and usually *small embryo*.

Leaves mostly alternate and simple, often *with sheathing bases* in herbaceous families. Stipules rare.

Exceptions:—

Fls. diœcious in *Menispermaceæ* and sometimes 2- or 4-merous but then carpel 1 with 3 *stigmas*.

Fls. epigynous in *Hernandiaceæ* with 4–7-partite perianth (sometimes 2- or 3-partite) and stamens opposite the perianth segments and isomerous, but leaves peltate as in *Menispermaceæ*, anthers opening by valves as in *Lauraceæ*. Ovary 1-carpellary, 1-ovuled.

Perianth often perigynous and monochlamydeous (rarely wanting) in *Lauraceæ*. Ovary sometimes syncarpous in *Nigella* (*Ranunculaceæ*), *Nymphæaceæ* (Water Lilies), and then fruit sub-capsular or with the torus forming a pseudo-berry. Carpels connivent and forming a pseudo-berry in *Anona*. Syncarpous but 3-carpellary and 1-celled in *Lauraceæ*.

Leaves opposite and sometimes pinnate in *Clematideæ*. Stipulate in *Magnoliaceæ*. Albumen scanty in *Ceratophyllaceæ*, 0 in *Lauraceæ* and *Hernandiaceæ*.

I. Woody families. St. hypogynous. Anthers not opening by valves. Carpels free or cohering in axis.
 1. *Ranunculaceæ* (part); 2. *Magnoliaceæ*; 3. *Dilleniaceæ*; 4. *Anonaceæ*.

II. Herbaceous families.
 St. numerous hypogynous.
 1. *Ranunculaceæ*.
 St. often sub-perigynous. 6. *Nymphæaceæ*.
 St. often in 3-merous whorls and few. 5. *Menispermaceæ*.
 Aquatic with much reduced 1-sexual fls. 7. *Ceratophyllaceæ*.

III. Woody, rarely herbaceous, with anthers 2- or 4-celled, opening by lids or valves, fls. hypogynous to epigynous.
 8. *Berberidaceæ*; 9. *Lauraceæ*; 10. *Hernandiaceæ*.

1. Buttercup and Clematis Family (see 1a)

Herbs with simple or sometimes compound, frequently deeply cut and palmately-nerved, *radical or alternate leaves with a sheathing petiole*. Stipules 0. *Flowers partly acyclic* with usually *many stamens*

and an *indefinite number of carpels* forming an *apocarpous ovary*. Fruit mostly of achenes or follicles. Sepals sometimes petaloid.
Ranunculaceæ (p. 3).

1a. Tribe Clematideæ.

As above, but mostly woody climbers with opposite leaves, petiole not sheathing........................*Clematis* and *Naravelia* (p. 3).

Exceptions :—

Petals 0 in *Clematis* and *Thalictrum* and calyx petaloid. Carpels connate except at tip in *Nigella*.

---

2. Magnolia Family.

Trees with *simple leaves* and the leaf-buds enclosed in convolute deciduous stipules which leave an annular scar as in many *Moraceæ*. *Flowers large solitary partly acyclic*. Sepals often petaloid and passing gradually into petals, *in 3-merous whorls. Torus much elongate in fruit with spicate carpels sometimes more or less connate, dehiscent or indehiscent*..............................*Magnoliaceæ* (p. 8).

3. The Dillenia Family. —→ *Theales.*

Trees or shrubs with large *very strongly pinnately-nerved leaves and sheathing petioles. Flowers large or very large. Sepals and petals* definite, *mostly* 5. *Stamens many*, sometimes connate below. *Carpels* 5–20 *cohering in the axis*. Fruit indehiscent, enclosed in the large fleshy accrescent calyx..........................*Dilleniaceæ* (p. 6).

This family forms a connection with the *Theales*, in which it is sometimes placed.

4. Custard-apple Family.

Trees, shrubs or woody climbers. Leaves sometimes dotted, sometimes aromatic. *Buds naked, stipules* 0. Fls. small or medium, rarely large, often sub-solitary. *Perianth of* 3 *trimerous whorls*, one or more whorls often fleshy or coriaceous or petaloid, inner valvate. *Stamens many with adnate anthers. Carpels* few or many, *stalked and umbelled in fruit*. Seeds large with copious albumen and small embryo, the *albumen deeply usually laminately ruminate*......*Anonaceæ* (p. 9).

Exceptions :—

Carpels cohering into a fleshy fruit in *Anona*, but marked externally by more or less distinct areoles.

---

5. The Moonseed Family.

Slender, rarely woody climbers, with *simple palmately-nerved*, sometimes peltate *entire leaves. Fls.* small or minute, 1-*sexual*, in a many-fld., *often umbellate, inflorescence. Perianth* sepaloid, *of several*, usually 4, *trimerous whorls*. St. and carpels mostly in 3-merous whorls. *Fruiting carpels* 3–12, rarely only 1, *drupaceous* with usually a characteristic horse-shoe-shaped endocarp. Embryo moderate-sized in albumen............................*Menispermaceæ* (p. 16).

Exceptions :—

Male of *Cissampelos* is 4-merous with connate petals. *Stephania* has sometimes 5-merous whorls.

---

6. The Water-lily Family.

Aquatics with usually a rhizome and large floating or extruded often peltate leaves involute in vernation. *Flowers very large, acyclic,* at least as to petals and stamens, which are seated on a fleshy disc surrounding the carpels. Carpels several or many, whorled or connate into a many-celled ovary with a peltate stigma or free and scattered in the broad torus. Embryo outside a copious albumen or albumen 0 and plumule large..........................*Nymphæaceæ* (p. **20**).

7. The Hornwort Family.

Submerged aquatics with slender stems and whorled leaves 2–several times forked with filiform segments. *Flowers minute, monœcious,* usually solitary. *Perianth of* 6–12 *narrow subvalvate segments. St.* 12–30 on a convex torus. *Ovary of one ovoid* 1-*celled carpel* with a subulate style and *a solitary pendulous straight ovule.* Fruit small, indehiscent, beaked with the style. Seed with scanty albumen. Embryo straight with 2 cotyledons, radicle very short inferior.
Ceratophyllaceæ (p. **841**).

---

8. The Barberry Family.

Often spiny shrubs with scaly buds. Leaves simple or compound often spinous, rarely stipulate. Fls. small or medium, yellow, racemose. *Perianth of four* 3-*merous whorls. Stamens* 3–6 *opposite the petals,* anthers with adnate cells dehiscing by recurved valves. *Carpel* with a large sessile orbicular stigma. *Ovules several basal.* Fruit baccate................................*Berberidaceæ* (p. **19**).

9. The Laurel Family.

Trees, rarely shrubs (see exc.). *Leaves* alt., rarely opp. or subverticillate, *entire,* usually with a *characteristic aromatic or camphoraceous smell* due to minute glands often visible as translucent dots; exstipulate. *Flowers small,* green or yellowish, *regular* 1–2-*sexual, mostly* 3-*merous* throughout. *Tepals usually* 2-*seriate,* often connate below, rarely 5 or rudimentary or 0. *Stamens in* 2–4 *trimerous whorls,* one whorl often reduced to staminodes, *hypogynous or perigynous,* anthers with 2 or 4 cells dehiscent by small lids. *Ovary syncarpous,* 3-*carpellary,* 1-*celled. Ovule* 1 *pendulous anatropous.* Fruit baccate drupaceous or nearly dry. Seed exalbuminous. Embryo with large plano-convex cotyledons, radicle superior minute.
Lauraceæ (p. **791**).

Exceptions:—

Cassytha is a parasitic filamentous leafless green climber with haustoria.

10. The Hernandia Family.

Woody plants with alternate sometimes clustered *often peltately attached and palmately nerved, entire or lobed leaves,* exstipulate, usually with oil glands, cystoliths or capitate hairs. *Flowers small* 1–2-*sexual* clustered in axillary or pseudo-terminal cymes or panicles, regular with 3–many (4–7 in our species), rarely 2- (in female) partite perianth,

tepals usually 2-seriate. Stamens as many as and opposite the tepals, sometimes with as many alternating glands, *anthers opening by lateral recurved lids. Ovary inferior 1-celled* with 1 pendulous anatropous ovule. Fruit indehiscent sometimes crowned by the wing-like tepals. Seed with convolute cotyledons.............. *Hernandiaceæ* (p. 799).

Order II. ARISTOLOCHIALES.

Position very doubtful.* Fls. cyclic, homoiochlamydeous, epigynous, reg. or zyg. Perianth petaloid. Gynæcium and andrœcium mostly 3-merous. Ovules many parietal.

11. The Snake-root Family.

Herbaceous or shrubby climbers with alt. usually palminerved leaves and base of petiole dilated or decurrent, exstipulate. Leaves often with secretory cells giving rise to translucent dots. *Flowers 2-sexual regular or zygomorphic 3-merous* (or perianth 1–2-lipped when zygomorphic) with green or coloured gamophyllous perianth with inflated base, lobes valvate. Stamens 6–12 subsessile in a ring round the base of the style with which they are often combined into a column or gynostenium; if free then filaments short and thick. *Ovary inferior* or partially so, 4- or 6- rarely 5-celled, stigma rayed. Ovules many, anatropous on parietal placentæ which are free or meet in the axis, or placentæ axile. Fruit capsular or coriaceous and bursting irregularly, *in our species ribbed and septicidally 6-valved and the dehiscence carried down into the pedicels. Seeds many with copious albumen and small or minute embryo.........Aristolochiaceæ* (p. 784).

Order III. OPUNTIALES.

Fleshy plants with the leaves often reduced to scales and bearing hairs, bristles or spines in their axils. Flowers hemicyclic, heterochlamydeous with many spirally arranged tepals, the sepals passing into petals and with the stamens seated on a large tubular hypanthium in which is sunk the ovary. Ovary of 4 to many carpels, 1-celled with parietal placentation.

Apparently allied to the *Mesembryanthemæ* (*Aizoaceæ*).

Families: 12. *Cactaceæ.*

12. The Cactus Family.

Succulent, sometimes very fleshy plants, *without milky juice,* with columnar, clavate, spherical or terete, compressed or angled stems and branches, rarely (*Pereskia*) with well-developed leaves. Fls. usually large. *Perianth regular or somewhat zygomorphic, with many tepals from a tubular hypanthium. St. very many inserted at various levels in* the *same* hypanthium. *Ovary inferior 1-celled* with *several parietal placentæ.* Ovules many anatropous. *Seeds many with*

* I follow Hutchinson in placing them in the neighbourhood of the *Ranales* in view of their commonly 3-merous flowers, etc.

curved embryo more or less terete or clavate and scarcely differentiated or with 2 thin or fleshy cotyledons. Albumen scanty or copious.

Cactaceæ (p. **400**).

Order IV. CARYOPHYLLALES (Curvembryeæ).

Herbs, rarely shrubs, with simple entire exstipulate leaves, or stipules scarious. *Flowers regular*, sometimes heterochlamydeous, but *usually reduced and haplochlamydeous*, solitary or cymose or in abbreviated cymules aggregated into spikes and panicles. *Perianth usually polyphyllous* and *hypogynous* and *usually persistent in fruit*, sometimes gamophyllous and perigynous. *Stamens* sometimes numerous, *usually diplostemonous or fewer*, if isomerous then opposite the sepals (petals wanting), sometimes perigynous. Ovary of 2–5 *carpels connate into a 1-celled ovary* with *basilar or central columnar placentation*. Ovules often reduced to one, *campylotropous* or *amphitropous*. *Embryo curved around the mealy albumen.*

This order (*i. e.* its theoretical extinct allies) would appear to be the origin of *Primulales* among *Gamopetalæ*.

Sub-order CARYOPHYLLALES proper.

Mostly dichlamydeous with often showy flowers. Stamens indef. or definite. *Ovules several.*

13. *Aizoaceæ* ; 14. *Portulacaceæ* ; 15. *Caryophyllaceæ*.

Sub-order CHENOPODIALES.

Haplochlamydeous with usually small flowers. Stamens definite. *Ovule* 1.

16. *Nyctaginaceæ* ; 17. *Phytolaccaceæ* ; 18. *Chenopodiaceæ* ; 19. *Amarantaceæ*.

Exceptions :—

Leaves sometimes 0 in the fleshy species of *Chenopodiaceæ*.

Ovary incompletely 3–5-celled with many ovules, flowers mostly heterochlamydeous, petals often with a ligula, stamens often on a column in *Caryophyllaceæ*.

Ovary 1-many-celled in *Aizoaceæ*.

Stamens numerous in some *Nyctaginaceæ* and fruit nut-like.

Carpels sometimes whorled in *Phytolaccaceæ* with 1 ovule in each carpel and fruit sometimes then coccous.

The *Nyctaginaceæ* are included in *Thymeleales* by Hutchinson, who also includes the *Elatinaceæ* here rather than in *Theales*. The embryo is sometimes curved in *Elatinaceæ*, which has, however, completely axile placentation and little or no albumen. Their fruit is a septicidal capsule which occurs nowhere else in *Caryophyllales*.

On the other hand a septicidal capsule is not very far removed from a coccous fruit which sometimes occurs and the habit of *Elatinaceæ* is rather that of *Caryophyllales* than of *Theales*.

13. The Fig-marigold Family. ←— *Opuntiales*.

Herbs or undershrubs with sometimes fleshy, alt. opp. or pseudo-verticillate leaves, stipules scarious or 0. Fls. in our genera small. *Tepals* 5–3. *St.* 3–10 *or indefinite*, free or in bundles or connate below in a ring, *hypogynous or perigynous*. *Ovary* free superior to inferior *1-several-celled* with as many styles as carpels. Ovules 1–many in

each cell. Fruit usually capsular, sometimes circumsciss. Seeds many or few–1 in each carpel, hilum sometimes appendaged. *Embryo curved or annular*..............................*Aizoaceæ* (p. 47).

The Fig-marigolds (*Mesambryanthemæ*) are sometimes separated as a distinct family chiefly by their large *usually brilliantly coloured petals* and *indefinite stamens*. They are chiefly succulent plants, native of the hot sandy plains of S. Africa, but are sometimes grown in gardens in India. *M. crystallinum* is the Ice plant.

14. The Purslane Family.

Succulent herbs or undershrubs with alt. or opp. or subverticillate simple entire leaves with often bundles of hairs (stipular ?) in their axils. Fls. regular, opening only in sunshine. *Sepals* 2 only (bracts?), free or somewhat connate. *Petals* 4–6 *free* or somewhat connate. St. variable in number, sometimes opposite the petals, inserted with them. *Ovary* 1-*celled, free or sunk in the torus,* of 2–8 carpels. Ovules 2–many, *on a central basal placenta.* Fruit opening by valves or circumsciss..............................*Portulacaceæ* (p. 46).

15. The Carnation Family.

Herbs with stems often tumid at the nodes and opposite entire exstipulate leaves or stipules scarious. *Sep.* 4–5 *free or connate. Pet.* 4–5 *or* 0, free, *clawed,* usually on an internode above the insertion of the sepals. *Stamens normally diplostemonous,* sometimes reduced in number, inserted with the petals, *free or monadelphous or in a perigynous ring. Ovary free* 1-*celled or* 3–5-*celled at the base,* with 2–5 free or connate styles. *Placentation central.* Fruit capsular. *Embryo mostly curved* with narrow incumbent cotyledons.
Caryophyllaceæ (p. 43).

16. The Bougainvillea Family.

Woody or herbaceous with opp., rarely alt., entire exstipulate leaves. *Flowers* small or medium, *often showy from being subtended by an involucre of coloured bracts, at other times minute,* in heads, cymes or umbels. *Perianth gamophyllous usually petaloid* with the *tube persistent and accrescent,* 3–5-lobed, plaited in bud. *St.* 8–30 *hypogynous,* anthers didymous. *Ovary free,* 1-carpellary, style involute in bud with simple or multifid stigma. *Ovule* 1, *erect, somewhat campylotropous. Fruit* thin-walled, *enclosed in the hardened perianth-tube.* Seed erect albuminous with *embryo either curved or spiral or straight with crumpled or folded cotyledons*..............................*Nyctaginaceæ* (p. 755).

17. The Phytolacca Family.

Shrubs or herbs with alt. leaves. Stipules small or 0, never ochreate. Fls. racemose. *Tepals* 4, *rarely* 5 *imbricate,* sepaloid or petaloid. *Stamens* 4, *rarely* 5, opp. the tepals or diplostemonous, rarely more, hypogynous or sub-hypogynous, *filaments often persistent. Carpels* 1, *or several in a whorl,* free or connate, superior, 1-*ovuled,* stigmas usually sessile and recurved. *Seed erect,* often arillate, albuminous. *Embryo peripheral annular. Cotyledons* sometimes unequal, *outer embracing the inner*..............................*Phytolaccaceæ* (p. 772).

18. The Spinach and Beet Family.

Herbs or small shrubs, often halophilous and fleshy, sometimes with a coating of wax or globular trichomes. *Leaves alternate,* mostly entire exstipulate, *sometimes* 0 *in fleshy species. Flowers usually green,* 1-2-*sexual,* often dimorphic, sometimes ebracteate. *Perianth herbaceous or membranous,* persistent and of 3–5 *free or connate tepals,* imbricate in bud, or sometimes 0. *Stamens* 5 *or fewer,* opp. the tepals, hypogynous or perigynous. *Ovary* 1-*celled* with usually 2, more rarely 3–4, very seldom 5 stigmas (1–5-carpellary). *Ovule* 1 *campylotropous* with 1–2 integuments, *on a basal funicle. Fruit a utricle,* often enclosed in the accrescent perianth. Seed albuminous or not. *Embryo curved, annular or spiral............Chenopodiaceæ* (p. **769**).

19. The Amaranth Family.

Herbs, rarely shrubs or undershrubs with opp. or alt. exstipulate *usually entire leaves. Fls. small, green or coloured, of chaffy texture and often shining,* sometimes 1-sexual, *in dense heads or spikes or panicled clusters. Bracts and* 2 *bracteoles nearly always present* and resembling the perianth in texture. Tepals 5 persistent, imbricate. *Stamens* 1–5 *opposite the tepals or diplostemonous with the alternate ones reduced to staminodes,* filaments often united into a ring or cup at base. *Ovary* usually free sometimes adnate to the perianth in fruit, of 1–3 carpels, 1-*celled.* Styles 0–3, rarely 4. *Ovules* 1, rarely (*Celosieæ*) several, *campylotropous, erect basilar, or pendulous from a slender basal funicle. Fruit a utricle,* rarely baccate capsular or nut-like. Seed compressed, testa hard. *Embryo annular or horseshoe-shaped, albumen mealy.*
Amarantaceæ (p. **758**).

Order V. POLYGONALES.

Herbs, rarely shrubs, often with swollen nodes. *Leaves* simple entire, usually alternate, *frequently dotted and with connate or tubular membranous stipules which sheath the terminal bud. Flowers* 1–2-*sexual, small,* regular, bracteate, in spikes or heads, *mostly* 3–5-*merous and haplo- or homioichlamydeous* or much reduced and perianth 0. Stamens hypogynous or slightly perigynous, 5–8 or sometimes reduced to 2, when isomerous then opposite the tepals. *Ovary* 1-*celled of* 3–1 *carpels or carpels free,* with 1 (rarely more) *basal erect orthotropous ovule.* Embryo in copious albumen.

The *Piperaceæ* have possibly only superficial resemblances to the *Polygonaceæ,* with which they are united. The structure of the stem with scattered bundles, somewhat like the monocotyledons* and water-lilies, sometimes apocarpous ovary, minute embryo and other characters *may possibly* point to their being allied to the *Ranales,* in which combination of orders Hutchinson places them. The straight ovule, however, is very unlike any of the *Ranales,* as is the inflorescence.

Families: 20. *Polygonaceæ ;* 21. *Piperaceæ.*

* The bundles are usually in irregular rings with wood and bast normally orientated and mostly *open.* The resemblance to those of the Monocotyledons and water-lilies is therefore only superficial.

20. The Dock and Rhubarb Family.

Herbs, rarely shrubs, occasionally scandent (twining or with tendrils). *Stipules mostly membranous and ochreate. Fls.* usually 2-sexual, *jointed on the pedicel,* usually clustered, *clusters often spicate or panicled. Perianth of* 3–6 *free or connate persistent tepals* imbricate in bud. St. 5–8, *rarely more or fewer, opp. the tepals. Ovary free,* 2–3-gonous with 1–3 styles. Fruit a nut, usually enclosed in the sometimes accrescent perianth. Embryo various, radicle superior. . . . . *Polygonaceæ* (p. **773**).

---

21. The Pepper Family.

Herbs or shrubs often climbing by means of adventitious roots, *aromatic with secretory cells. Leaves often palmately nerved. Stipules connate and intrapetiolar or adnate or* 0. *Fls.* minute, achlamydeous, 1–2-*sexual* in *bracteate spikes, bracts usually peltate or adnate to rhachis.* St. 2–6 rarely 1 or 7–8, hypogynous. *Ovary* 3–4-*carpellary,* 1-*celled, or of* 3 *or more carpels free or connate only below,* stigmas sessile. *Ovules* 1 *or more, orthotropous.* Fruit baccate, or from apocarpous ovaries coccous or follicular. Seeds globose. Embryo minute, enclosed in a sac of endosperm at one end of the copious floury perisperm. Cotyledons minute or obsolete, radicle superior. . . . . *Piperaceæ* (p. **786**).

Order VI. THEALES (Guttiferales).

(←— *Dilleniaceæ.*
—→ *Myrtales and Ebenales.*)

Woody, more rarely herbaceous, *often resinous* (juice then frequently yellow). Leaves opposite or usually alternate and penninerved, entire, often dotted.* Flowers regular, cyclic, mostly 5-merous or perianth 2–6-merous, hypogynous. Stamens many but *frequently in* 5 *bundles* or *somewhat connate* or in a central mass (flowers then 1-sexual), often several-seriate. *Ovary syncarpous* and *several-celled with axile placentation*; if 1-celled then ovules on the sutures of the carpels, not on their midrib. *Styles usually free and ending in a point.* Fruit never coccous. Albumen scanty or 0.

Exceptions :—

Flowers of *Theaceæ* sometimes hemicyclic.

Fls. of *Guttiferaceæ* often with sepals in decussate pairs as in *Parietales.* Ovules sometimes apparently parietal in some *Hypericaceæ,* but the placentæ sutural, not on midrib of carpels, and stamens in bundles.

Leaves of some *Hypericaceæ* and of *Guttiferaceæ* are opposite.

Elatinaceæ are small herbs.

Families : 22. *Hypericaceæ ;* 23. *Elatinaceæ ;* 24. *Theaceæ* (*Ternstrœmiceæ*) *;* 25. *Guttiferaceæ ;* 26. *Dipterocarpaceæ.*

The *Dilleniaceæ* are sometimes placed in this order, but they are mostly acyclic and ovary mostly apocarpous.

The Tamaricaceæ are placed in this order by Engler as a sub-order. The

---

* Secretory cavities appearing as translucent or black op aque dots.

Ochnaceæ are placed in this order by Engler and by Hutchinson. I have kept them in *Geraniales* on account of their lobed ovary and (in our species) coccous fruit, well-developed disc, free filaments, elongate basifixed anthers.

22. The Tutsan Family. (——→ *Parietales.*)

Herbaceous or woody with frequently resinous juice. Leaves entire, exstipulate. Flowers yellow, regular. Sep. and pet. 4–5. *St. many in 3–5 bundles.* Carpels 3–5 *united into a* 1*-celled or* 3–5*-celled ovary* with 3–5 free or united styles. Ovules few or many parietal or, in several-celled ovaries, axile from the intrusion to the centre and then recurving of the placentæ. Capsule septicidal, or dehiscing through the placenta in 1-celled ovaries, or septicidal-septifragal.

Hypericaceæ (p. **51**).

23. The Water-pepper Family.

Usually *small marsh herbs* with opposite or whorled simple stipulate leaves. Fls. very small. Sep. and pet. 3–5, free, imbricate. St. isostemonous or diplostemonous with versatile anthers. *Ovary with* 3–5 *cells and styles. Ovules many axile.* Capsule septicidal or loculicidally septifragal. Seeds and embryo straight or curved.

Elatinaceæ (p. **49**).

24. The Tea Family.

Woody plants with usually evergreen exstipulate leaves and small or showy, sometimes diœcious fls. Fls. solitary or clustered *subtended by 2 sepal-like bracts. Sep.* 4–7, *free or slightly connate. Pet.* 4–9, imbricate or contorted in bud, free or connate below. *Stamens many, outer in bundles and connate with the bases of the petals.* Ovary free sessile 3–5*-celled. Ovules 2–many in each cell, axile.* Frt. baccate or capsular. Seeds large, few. Albumen scanty or 0.

Ternstrœmiaceæ or *Theaceæ* (p. **55**).

25. The Gamboge Family.

Woody plants with resin canals containing a yellow milky juice. Leaves *evergreen opposite entire* with the *secondary venation often of very numerous fine parallel nerves* nearly at right angles to the midrib. Fls. often rather large, 1–2-sexual. *Sep.* 2–6 *imbricate or in decussate pairs.* Pet. 2–6 *imbricate or contorted.* St. many free *or monadelphous* in a dense central mass *or in bundles,* anthers dehiscing by pores or slits or transversely. Disc fleshy, sometimes lobed. Ovary 1–many-celled. Stigmas radiating free, connate or peltate. Ovules 1–2 or many, axile or basal and erect. *Seeds large, often arillate,* albumen 0.

Guttiferaceæ (p. **52**).

26. The Sal Family.

Trees with *resinous substances in the leaves, wood or bark.* Leaves alt. Stipules caducous. *Fls. panicled. Sep.* 5 *connate below, often unequal. Pet.* 5 *contorted,* sometimes connate at base. *St. usually a multiple of* 5. *Ovary slightly sunk in the broad concave torus,* 3*-celled with* 2 *ovules in each cell,* usually only one developing, style and stigma simple. *Fruit a nut more or less enclosed in the calyx, of which* 2 *or more sepals develop into linear wings.* Seed exalbuminous with 2 large fleshy cotyledons.......................... *Dipterocarpaceæ* (p. **56**).

Order VII. PARIETALES.

(←— *Theales.*)

Herbs, more rarely woody. Flowers cyclic regular to zygomorphic (if zygomorphic then ovary 3–2-carpellary) and whorls very often 2-merous or 4-merous, hypogynous to epigynous. Sepals and petals usually present and free, or sometimes connate. Stamens many or few, never in threes (apparently sometimes 3 in *Cucurbitaceæ* owing to 2 pairs being connate). Ovary syncarpous, sometimes on a gonophore), of 2–3 or rarely more *carpels* forming a 1-*celled ovary with parietal placentation.* Placentæ on the *midrib or mesial line of the carpels*,* which sometimes nearly meets in the axis, or scattered all over the walls of the carpel (as in *Carica*), or on the edges of the carpel (*e. g. Cruciferæ*) and ovary sometimes divided by a replum. Leaves mostly simple alternate.

Exceptions (see also brackets under the sub-orders).

Leaves decompound in *Moringaceæ* (position of which is very doubtful), palmately compound in some *Passifloraceæ* and *Cucurbitaceæ*.

Flowers irregular in many *Fumariaceæ, Violaceæ, Moringaceæ*, and slightly so in a few others.

Stamens often connate in pairs (and an odd one, with 1-celled anthers) in *Cucurbitaceæ* ; united into a tube below in some *Flacourtiaceæ*.

Corolla often gamopetalous in *Cucurbitaceæ* and *Caricaceæ*.

Ovary several-celled by intrusion of the placentæ in some *Flacourtiaceæ* and placentæ, nearly meeting in several other cases, the cell often filled with pulp. Placentæ adnate to axis in *Begoniaceæ*.

Sub-order RHŒADINÆ (p. 107).

Perianth whorls 2-(–4)*merous* often a tetramerous corolla placed diagonally, stamens many or few. Ovules truly parietal or apparently on the carpellary margins and often margins united by a replum (in *Cruciferæ* and some *Capparidaceæ*).

27. *Papaveraceæ;* 28. *Capparidaceæ;* 29. *Cruciferæ;* 30. *Fumariaceæ.*

Sub-order CISTINEÆ (p. 108).

Sep. and pet. 4–5. St. many. Ovary superior with 2–5 placentæ.

31. *Bixaceæ.*

Sub-order FLACOURTINEÆ (p. 108).

Fls. often 1-*sexual* and *sometimes perigynous. Petals often failing*, sometimes with a ligule (*Turneraceæ*). *Placentæ* 3. Stamens 5 or more numerous in 1–many series.

32. *Flacourtiaceæ ;* 33. *Violaceæ ;* 34. *Turneraceæ ;* 35. *Pittosporaceæ.*

* This, apparently, is not the view of the text-books, which, so far as I know, never refer to placentation on a mid-rib, although they necessarily admit cases of ovules scattered all over the wall. The theory of mesial placentation is based on the position of the stigmas, which it is assumed are median and over the midrib of the carpel as is evident in most cases. Were such mesial placentation constant it would form a valuable character for the *Parietales*, but some families in the order have the ovules distinctly on the margins of the carpels. As there are all grades of ingrowing of the margins until they meet in the axis, there appears in many cases to be little significance in the so-called parietal placentation where marginal as in distinction to purely axile, and I fear that the order *Parietales* is a very heterogeneous group.

Sub-order TAMARISCINEÆ * (p. 109).

St. iso- or diplostemonous on the margins of a crenulate disc. Carpels 3. Placentation sub-basal.
36. *Tamaricaceæ* (position doubtful).

Sub-order MORINGINEÆ * (p. 109).

Sep., pet., and st. on the margins of a perigynous disc. Fls. irregular, calyx petaloid. Carpels 3.
37. *Moringaceæ* (position doubtful).

Sub-order PASSIFLORINEÆ * (p. 109).

Fls. regular or nearly so. Stamens very many to definite. *Ovary of 3 carpels united into an inferior* or rarely superior in (*Passifloraceæ* and *Caricaceæ*) *ovary*, placentæ sometimes meeting in or adnate to axis. Mostly herbs climbing by tendrils. *Carica* a small tree with latex.
38. *Caricaceæ;* 39. *Passifloraceæ;* 40. *Cucurbitaceæ;* 41. *Begoniaceæ.*

Sub-order RHŒADINEÆ (p. 106).

27. The Poppy Family.

Herbs with *milky juice.* Flowers regular. *Sepals* 2 *or* 3. *Petals* 2 + 2 or 3 + 3. *Stamens many.* Ovary 1-celled with 2–*several parietal placentæ* often (*Papaver*) projecting as lamellæ from the mid-ribs of the carpels (the lamellæ immediately under the stigmas), stigmas where many radiating and often connate into a disc. Fruit capsular. Seeds many small, albuminous.................*Papaveraceæ* (p. **22**).

28. The Caper Family.

Woody or herbaceous. Leaves simple or digitate, stipules when present sometimes converted into prickles. Fls. regular. *Sep.* 4. *Pet.* 4. *St.* 4 *or* 4–8 (if 6 then not tetradynamous) *or many.* Ovary *usually on a gynophore*, 1-celled with 2–4 parietal placentæ. Replum sometimes present in 2-celled capsules. Ovules many *camplotropous.* Fruit capsular or baccate. Seeds exalbuminous. *Embryo curved or spiral*..............................*Capparidaceæ* (p. **29**).

29. The Mustard and Cabbage Family.

Herbs with exstipulate alt. leaves. Fls. regular or outer (in a corymb) radiant. *Sep.* 4 *free. Petals* 4. *St.* 6, *of which* 2 *are shorter solitary* opposite the lateral sepals and 4 *longer* paired opposite the median sepals (*tetradynamous*), very rarely stamens only 4 or 2. Ovary of 2 carpels, septate longitudinally by a replum.
Cruciferæ (p. **24**).

Exceptions :—

Some cultivated forms of *Brassica* have several carpels and a similar number of valves to the fruit.

---

* These sub-orders have little in common either with preceding or with one another.

30. The Fumitory Family.

Herbs with watery juice, often rambling or climbing. Leaves usually lobed or dissected. *Fls. irregular, racemose. Sepals* 2 very small and deciduous. *Pet.* 2+2, 2 *outer larger.* St. 6 in two bundles opposite the outer petals. *Ovary* 1-*celled. Placentæ* 2. Ovules 2 or more parietal, or 1 placenta sterile and ovule 1.

Fumariaceæ (p. 23).

Sub-order CISTINEÆ (p. 106).

31. The Arnatto Family.

Woody plants with palminerved or palmately-lobed large leaves and usually minute caducous stipules. Flowers large, regular 2-sexual, panicled. *Sep.* 4–5 *free. Pet.* 4–5 *free, large. St. many.* Ovary 1-celled with parietal placentation and *many anatropous ovules. Carpels* 2–5. Style slender. Fruit a 2–5-*valved capsule.* Seed sometimes comose or arillate. Albumen copious. *Embryo usually curved.*

Bixaceæ (p. 34).

Sub-order FLACOURTINEÆ (p. 106).

32. The Flacourtia and Casearia Family.

Woody plants with usually penninerved leaves* frequently dotted. Stipules small caducous. Fls. *small often* 1-*sexual.* Sepals 4–*several* hypogynous or sub-perigynous. *Petals small or* 0, 1–3-*times as many as sepals or indefinite.* Torus often with glands. St. definite or indefinite, if isomerous with petals then opposite to them, *often perigynous.* Ovary superior to inferior, 1-*celled with* 2–8 (usually 3–5) placentæ or as many-celled. Seeds 1 or more, sometimes arillate.

Flacourtiaceæ (p. 35).

33. The Violet Family.

Herbs with entire stipulate leaves. *Fls. irregular. Sep.* 5 *persistent* imbricate. *Pet.* 5 *hypogynous,* lower dissimilar. *St.* 5 hypogynous or slightly perigynous. Anthers often crested. Ovary 1-celled with many *anatropous ovules* on 3 *parietal placentæ,* style 1. Fruit a 3-*valved loculicidal* capsule. Seeds albuminous....... *Violaceæ* (p. 32).

34. The Turnera Family.

Herbs or shrubs with alt. leaves usually 2-glandular at the base. Stipules small or 0. *Fls. regular, yellow,* 2-sexual. *Hypanthium short usually swollen at the insertion of the stamens.* Sep. 5. Pet. 5, inserted at the base of the hypanthium. *St.* 5 *more or less perigynous.* Ovary *free* 1-*celled with* 3 *parietal placentæ* and 3 *styles.* Ovules many anatropous. Fruit a 3-*valved capsule* bearing the seeds in the *middle of the valves.* Seeds oblong curved with a membranous aril, fleshy albumen and terete embryo.................. *Turneraceæ* (p. 383).

* Although the leaves are mostly penninerved the cotyledons are often palminerved.

35. The Pittosporum Family.

Woody plants. Leaves alt. or sub-verticillate, exstipulate. Fls. *regular, 2-sexual.* Sep. 4–5. *Petals 4–5, coherent at base,* hypogynous. *St. isomerous. Ovary* sessile, *incompletely 2–3-celled* by the projection of the parietal placentæ. Style 1. Ovules anatropous 2 or more on each placenta. *Fruit capsular, 2–3-valved, the valves bearing the seeds along their mesial line.* Embryo minute near the hilum, in fleshy or leathery albumen.......................... *Pittosporaceæ* (p. **39**).

Sub-order TAMARISCINEÆ (p. 107).

36. The Tamarisk Family.

Woody plants with scale-like leaves. Fls. regular, spiked or racemed. *Sep. and pet. 5, rarely 4,* imbricate, free or connate below. St. *iso- or diplostemonous, on the margin of a crenulate disc* which is sometimes *sub-perigynous*; anthers versatile. *Ovary free 1-celled,* styles or sessile *stigmas* 3–5. Ovules usually many, anatropous. *Capsule 2–3-valved,* placentæ either at base or mesial on the valves. *Seeds comose.* Albumen 0 (in our genus). *Embryo straight*..... *Tamaricaceæ* (p. **50**).

Sub-order MORINGINEÆ (p. 107).

37. The Horseradish Tree Family. Affinities very doubtful.

Small trees with alt. 2–3-*pinnate deciduous leaves.* Fls. *zygomorphic,* 2-sexual. Sep., pet. and st. on the margin of the disc which lines a *cupular perigynous hypanthium. St. in 2 whorls,* the episepalous ones often reduced to staminodes, *anths. 1-celled.* Ovary *1-celled with 3 placentæ.* Ovules numerous, 2-seriate on each placenta, anatropous with ventral raphe. *Fruit pod-like, 3-valved.* Seeds on the central line of each valve, 3-winged or wingless. Albumen 0. Embryo straight with thick cotyledons.................. *Moringaceæ* (p. **225**).

Sub-order PASSIFLORINEÆ (p. 107).

38. The Papaya Family.

Small tree with usually a simple crown of very large *palmately-lobed* leaves and *milky juice.* Fls. monœcious or diœcious, or male and hermaphrodite. Corolla of male gamopetalous, of female larger, polypetalous. *St.* 10 *in two whorls,* fem. with staminodes. Ovary 1- or 5-celled superior with short style and 3–5 *palmately-branched stigmas.* Herm. fls. with 5 hypogynous stamens or stam. 10 perigynous or 10 epigynous. Ovules *very numerous,* scattered all over the walls of the ovary. Seeds albuminous............... *Caricaceæ* (p. **385**).

39. The Passion-flower Family.

Climbing by means of tendrils, rarely twining. Leaves *palmate or palmately-divided* and palminerved, frequently with few large glands or glandular areoles on under-surface or petioles. Hypanthium

usually well-developed tubular or campanulate with 3–5 sepals. Corona of 1-many-seriate filaments or paleæ usually present on a broad zone of the hypanthium inside the corolla, a thick annular disc sometimes inside the corona. Stamens 5, alternating with the petals. Ovary sometimes sub-sessile but *usually on a gonophore with the stamens*, 1-celled with 3 (*rarely* 4) placentæ. *Seeds arillate.* *Passifloraceæ* (p. 384).

40. The Gourd Family.

Climbing by means of tendrils. Leaves simple, often palmately lobed or pedately divided, rarely subpinnatifid ; *venation palmate or pedate.* Fls. small to very large, *monœcious or diœcious.* Calyx and corolla inserted on a variously shaped often elongate hypanthium which is constricted above the ovary, poly- or gamophyllous. St. inserted inside or on the hypanthium, normally 5, but often 2 prs. connate so that there are apparently 3 ; *anthers 1-celled, cells straight or vermiform.* Ovary 1-celled *with* 3 (–5) *placentæ,* sometimes placentæ meeting in the axis. Ovules usually many. Fruit a berry or finally with hard rind and sometimes opening by a stoppel. *Seeds exalbuminous with straight embryo*....................*Cucurbitaceæ* (p. 386).

41. The Begonia Family.

Succulent herbs with unequal-sided leaves and often persistent stipules. Fls. *monœcious, bilateral,* rarely quite regular. *Male* perianth of 2 *outer valvate opp. tepals* and 2 *or* 0 *smaller inner ones,* fem. per. of 2–5, rarely 6–8 tepals, if more than 2 then imbricate, the 2 *outer more or less covering the inner. St. many. Ovary inferior,* 2–4-, *usually* 3-*celled* with 2–4 free or partially connate styles. Ovules very many on axile or sub-axile placentæ. Fruit usually capsular, often winged. Albumen scanty or 0..........................*Begoniaceæ* (p. 400).

Order VIII. MALVALES.

Woody or herbaceous, with usually tenacious bast, alt. simple or palmately compound usually stipulate *leaves with palmate* (rarely pinnate) *venation* and *hairs usually stellate. Flowers usually regular,* rarely zygomorphic, usually 5-merous and dichlamydeous, bracteoles often present as an epicalyx. *Calyx valvate* gamosepalous or (most *Tiliaceæ*) free and *corolla hypogynous. Stamens usually many, often mono- or poly-adelphous,* more rarely diplostemonous or with one whorl suppressed, anthers 1–2-celled. *Ovary of 2–many carpels with axile placentation, often showing a tendency to become coccous, or follicular in fruit,* otherwise usually capsular and 3–5-celled.

Exceptions :

Stellate hairs few or absent in some *Bombaceæ, Corchorus,* few *Hibiscus.*
Petals 0 in *Sterculia.*
Carpels reduced to one in *Waltheria.*
Fruit drupaceous in *Grewia, Elæocarpus.*

Families : 42. *Tiliaceæ ;* 43. *Sterculiaceæ ;* 44. *Malvaceæ.*

42. The Jute Family.

Woody or herbaceous. Leaves rarely deeply lobed. *Flowers regular,* often small, *without an epicalyx. Calyx with free sepals* (connate below in *Brownlowia*), *deciduous. St. many, not united into a tube,* more rarely 10 or 5, anthers 2-celled. *Ovary* 2–10-*celled. Ovules anatropous. Fruit drupaceous or capsular.* Seeds 1-many, exarillate, usually albuminous.......................*Tiliaceæ* (p. **84**).

43. The Sterculia Family.

Woody rarely herbaceous. *Flowers regular or zygomorphous,* often polygamous. *Calyx persistent gamosepalous.* Epicalyx rarely present. *Stamens usually obdiplostemonous* with the alternate whorl often reduced to staminodes, rarely 5 only *but sometimes many, monadelphous or united into a tube* at the base. *Anths. 2-locular* and extrorse. Ovary usually 5-celled. *Fruit mostly capsular, sometimes follicular.*
Sterculiaceæ (p. **74**).

44. The Mallow and Cotton Family.

Woody plants or herbs. *Leaves simple with palmate venation or digitate. Fls. regular. Calyx usually persistent and gamosepalous. Epicalyx usually present. St. many united into a tube or* (Tribe *Bombaceæ*) more or less free and *pentadelphous, anthers ultimately* 1-*celled, cells often sinuous. Ovary of* 5- (*rarely* 3-) *many carpels separating into cocci when ripe* and leaving a persistent columella, *or fruit capsular. Ovules* 1-*more axile curved.* Seeds with scanty or 0 albumen. *Cotyledons* foliaceous, usually crumpled or folded and *palmately nerved*...............................*Malvaceæ* (p. **57**).

Order IX. EUPHORBIALES.

Habit very various, sometimes fleshy, aquatic in *Callitriche. Leaves* simple, *sometimes palmate or palmately nerved, alternate,* usually stipulate. *Flowers usually much reduced,* sometimes to a single stamen or single ovary *but sometimes heretochlamydeous*; 1-*sexual, regular, often* 2–3-*merous.* Stamens definite or indefinite, anthers 2- or 4-locellate, sometimes cells confluent into one. *Ovary most often of* 3 *carpels,* sometimes carpels 2, *connate into an entire or lobed* 3–2-*celled ovary with* 1–2 *ovules axile,* or pendulous from the inner angle of each cell. Fruit of 2-valved cocci or pyrenes or capsular, rarely baccate or drupaceous with a 3–1-celled stone. *Seeds albuminous.* Cotyledons usually large and flat and often palminerved.

Exceptions:—

Leaves opposite in *Trewia* (though alt. in the seedling); opp. or sub-verticillate in *Callitrichaceæ*.

Leaves 3-foliolate in *Bischofia*.

Stamens 1–3 in *Tragia* which has stinging hairs, 2–5 in *Antidesma* spp., 2–3 in *Sapium*.

Fruit sub-baccate in *Kirganelia, Flueggea, Bischofia,* etc., but not truly so as there is a thin endocarp which may be dehiscent or pericarp finally hardened.

Ovary 1-celled in *Antidesma* with usually 3 2-lobed styles.

Embryo terete in *Callitriche* with long radicle.

Families: 45. *Euphorbiaceæ*; 46. *Callitrichaceæ*.

45. The Croton and Castor-oil Family.

Woody, herbaceous or fleshy, *sometimes with milky juice,* stellate hairs frequent. *Fls.* reduced to a single pedicelled stamen or ovary in *Euphorbia, Pedilanthus* and *Synadenium,* in which case the flowers are arranged in an involucrate inflorescence resembling single flowers. *Perianth dichlamydeous, monochlamydeous or* 0, *usually* 3–5*-merous. St. many, or* 3–5, *frequently in a central column. Ovary of* 3 *carpels and* 3*-celled* (rarely 2-merous), *or sometimes carpels several round a central columella* (as in *Malvaceæ*)..............*Euphorbiaceæ* (p. 97).

Possibly a composite family derived from different sources, among which the *Celastrales* and *Rhamnales* have been suggested. The alliance of some tribes with the *Malvales* seems undoubted. There also appear to be affinities with some of the *Sapindales.*

46. The Water Starwort Family.

Small weak often aquatic herbs with opposite or sub-verticillate (when floating) leaves which are narrow entire and 3-nerved. Hairs sometimes stellate. Fls. monœcious, reduced to a single stamen or a single naked ovary, usually solitary axillary. *Ovary of* 2 *carpels each divided by a partition to form a* 4*-celled* 4*-lobed ovary* with 2 simple stigmatose styles. *Ovules* 1 *in each cell,* pendulous, with only 1 integument. Fruit splitting into 4 cocci or drupels. Seeds albuminous. Embryo central terete..........*Callitrichaceæ* (p. 149).

Order X. URTICALES.

Woody or herbaceous, often with tough long bast fibres (as in the *Malvales*) and frequently with palmate venation (as in that order). Leaves simple, stipulate. Latex cells and tubes abundant in some families (as in the *Euphorbiales*) and stinging hairs (with same structure as those of *Jatropha*) found in *Urticaceæ. Inflorescence rarely in simple spikes, usually in cymes or clusters,* often developing into large pseudocarps from the aggregate fleshy axes. *Flowers always much reduced, small greenish* (rarely red) *regular,* 1–2*-sexual. Male usually* 4–5*-merous* with *isomerous epitepalous stamens* or stamens fewer in some *Moraceæ. Female with a* 2–5*-toothed or -partite perianth,* or perianth rarely 0. *Ovary superior* 1*-celled of* 1–2 *carpels* with simple or 2-fid stigma. *Ovule* 1 *erect or pendulous.* Fruit usually small indehiscent with large embryo in scanty albumen. Embryo straight, curved or spiral, sometimes with one cotyledon conduplicately folded over the other.

Exceptions:—

Leaves palmately divided in *Cannabis* and seedling leaves of some *Moraceæ* pinnatifid.

Flowers when crowded inside an aggregate fleshy axis (forming a receptacle as in Figs) sometimes with a minute hyaline gamophyllous perianth of uncertain number of leaves and stamens often only 1 or 2.

Perianth 4–8-tepalous and stamens isomerous or more in *Ulmaceæ.*

Families: 47. *Ulmaceæ;* 48. *Cannabinaceæ;* 49. *Urticaceæ;* 50. *Moraceæ.*

47. The Elm Family.

Trees with 2-farious leaves *frequently with cystolith-cells* (sometimes visible as translucent dots); *stipules lateral or intrapetiolar. Flowers* usually polygamous or diœcious *in axillary clusters or cymes, or female sometimes solitary. Perianth 4–8-merous,* lobes free or connate. *Anthers erect in bud. Ovary of 2 median carpels,* usually 1-celled; *stigmas 2 large, or style 2–4-fid. Ovule 1 pendulous. Fruit indehiscent,* often samaroid or drupaceous. Albumen 0 or scanty. *Embryo straight or curved with flat or folded cotyledons........Ulmaceæ* (p. **806**).

48. The Hemp and Hop Family.

Shrubby or herbaceous *without milky juice, often resinous. Leaves* opp. and alt. *palmately nerved or palmately divided;* stipules persistent free. *Flowers diœcious,* males cymose, females in contracted cymes or heads with large bracts. *M. perianth with 5 imbricate tepals, filaments straight in bud. Fem. perianth entire,* much reduced. *Ovary* 2-carpellary, 1-*celled, with 2 large feathery stigmas. Ovule* 1, *pendulous anatropous.* Fruit an acheme. *Embryo curved or spiral.* Albumen present or not..........................*Cannabinaceæ* (p. **810**).

49. The Nettle Family.

Herbs or undershrubs, rarely shrubs or small trees, *sap watery. Leaves* opposite and alternate, *often palminerved* (usually 3-basal-nerved); *dots due to cystoliths frequent.* Stipules membranous, sometimes intrapetiolar. *Flowers monœcious or diœcious,* cymose or clustered, *cymules or clusters often in higher inflorescences.* Perianth sometimes 2–3-merous especially in the female, when the perianth is frequently gamophyllous and closely invests the ovary. *Filaments incurved in bud* with anthers reversed, dorsifixed. *Ovary superior,* probably 1-carpellary only, 1-*celled* with simple or 0 style and *papillose plumose or penicillate stigma. Ovule 1 sub-basilar, erect, orthotropous.* Fruit small indehiscent, usually invested by the perianth and sometimes accrescent and fleshy. Seed albuminous. Embryo straight.
Urticaceæ (p. **811**).

50. The Fig and Mulberry Family.

Woody plants, nearly always *with milky juice* contained in laticiferous tubes, *cystoliths often present.* Leaves very rarely opposite, rarely deeply cut; stipules deciduous, often large and sheathing and leaving a prominent annular scar at the node like that of many *Magnoliaceæ. Flowers* small or minute, diœcious or monœcious, *cymose,* more rarely spiciform, the *cymes often dense and in some genera with their axes coalescent into a common floral receptacle,* in *some genera very fleshy* and *bearing the numerous minute flowers scattered outside* or by *peripheral growth inside the receptacle* (figs.). Tepals usually 4, seldom 2, 3, 5, or 6, free or connate, female perianth often accrescent in fruit. *Ovary* 2-carpellary, 1-*celled. Ovule* 1 *pendulous from apex, amphitropous* with micropyle superior, *rarely basal and orthotropous. Fruit often aggregated into large fleshy pseudocarps* with the enlarged

receptacle. Seed albuminous or not. *Embryo mostly curved with unequal cotyledons*, thick flat or one folding the other.

Moraceæ (p. 819.)

Order XI. GERANIALES.

(←— *Malvales.*)

Herbaceous or woody, *frequently with resin passages or secretory cells or glandular.* Leaves simple or *very commonly pinnate, occasionally digitate*, often dotted or aromatic. *Flowers regular*, rarely irregular (see exceptions), 2-sexual, 3–5-merous, hypogynous. Sepals often connate at the base. *Torus raised* in *centre into the centre of the ovary, or disc well developed and hypogynous*, annular or tubular or of glands only. *Stamens* inserted outside the disc, free or connate into a tube, *diplostemonous or obdiplostemonous*, one whorl sometimes reduced to staminodes (or absent in *Balsamineæ*). Ovary of 3–5 rarely more or of 2 *carpels*, syncarpous but *frequently lobed* and *carpels* sometimes nearly or quite free (*coccous*) in fruit. *Fruit* various, *often coccous* or splitting into pyrenes or drupaceous. *Ovules* 1–2 *in each cell*, usually pendulous with ventral raphe and superior micropyle.

Exceptions :—

Disc often feebly developed or 0 in sub-order *Gruinales* and flowers often irregular and spurred in the same sub-order and stamens only 5 in *Impatiens*.

Fls. 3–7-merous in some *Meliaceæ, Rutaceæ, Burseraceæ* and *Anacardiaceæ*.

Stamens sometimes only 2–3 in hermaphrodite flower of *Simarubaceæ*, 5 in few *Anacardiaceæ* (reduced to 1 perfect in *Mangifera* with staminodes), and very few *Meliaceæ*, many in some *Ochnaceæ* and few *Rutaceæ* (only 2–5 in *Toddalia*).

Carpels sometimes 1 only or 3–6 free in *Anacardiaceæ*, often numerous in *Ochnaceæ* and some *Rutaceæ* (*Citrus*).

Ovules numerous in each carpel in some *Meliaceæ* (Tribe *Swieteniеæ*), 3-more in *Balsaminaceæ*, some *Oxalidaceæ* (e. g. *Averrhoa*), some *Zygophyllaceæ*, few *Rutaceæ*.

Ovule only one in each cell in *Anacardiaceæ* with inferior micropyle and dorsal raphe. The family is usually placed in the *Sapindales*.

Sub-order GRUINALES (p. 115).

Disc usually poorly developed (well developed in *Ochnaceæ* and *Zygophyllaceæ*) or perhaps represented by the connate base of the stamens or of glands, sometimes 0. Torus often projected as a cone or beak into the centre of the ovary. Corolla sometimes spurred and irregular (some *Geraniaceæ, Balsaminaceæ, Tropæolaceæ*). (The *Malpighiaceæ* might also be included here.) Fruit various but often 5-ridged or -coccous, carpels sometimes adnate to the beak, when this is present, and elastically recoiling when ripe.

Families : 51. *Ochnaceæ ;* 52. *Linaceæ.;* 53. *Zygophyllaceæ ;* 54. *Geraniaceæ ;* 55. *Balsaminaceæ.*

The *Ochnaceæ* are perhaps related to the *Theales*.

Sub-order RUTALES (p. 116).

Hypogynous disc tubular or well developed. Flowers often polygamous. Leaves very frequently pinnate.

Families : 56. *Rutaceæ ;* 57. *Meliaceæ ;* 58. *Simarubaceæ ;* 59. *Burseraceæ ;* 60. *Anacardiaceæ.*

Sub-order GRUINALES (p. 114).

51. The Ochna Family. (Description mainly confined to *Ochna.*)

Glabrous trees or undershrubs with alt. *simple stipulate leaves. Fls.* usually *showy yellow,* sometimes umbelled. *Sep. persistent* and often deeply *coloured in fruit. Pet.* 5–10. *St. many on the large disc* which is yet larger in fruit and is projected into the centre of the ovary as in *Geraniaceæ* (drupels adnate to a central column); *anthers* elongate basifixed *opening by terminal pores* or longitudinally. *Ovary deeply* 3-10-*lobed,* the *lobes becoming drupels in fruit.......Ochnaceæ* (p. **169**).

52. The Flax Family.

Shrubs or herbs with *alt. simple entire leaves,* sometimes stipulate. Sep. 4–5 free or connate below. Petals fugacious. *Alternate stamens usually reduced to staminodes ; fil. united at the base* into an hypogynous or sub-perigynous ring. *Ovary* 3–5-*celled,* not lobed, *styles* 3–5. *Fruit drupaceous or septicidally separating into* 3–5 *cocci,* the cocci not adnate to a central column. Seeds with little or 0 albumen. Embryo straight, rarely slightly curved....................*Linaceæ* (p. **150**).

53. The Beancaper Family.

Woody or herbaceous, sometimes thorny, *with opposite,* rarely alternate (*Peganum*) *usually pinnate* (sometimes with 2 lflts. only) stipulate *leaves.* Sep. and pet. 5, rarely 4, free or united at the base. *St.* (12–15 in *Peganum*) *outside disc,* often appendaged at base with a scale. *Ovary more or less* 4–5-*furrowed* with 4–5 cells, rarely only 2–3- or 5–12-lobed and -celled. Ovules 1–several axile pendulous in each cell. Fruit capsular or of cocci, or (*Balanites*) drupaceous with a hard 5-angled endocarp with only 1 cell developing. Seeds albuminous or not. Embryo with large cotyledons and straight superior radicle.
Zygophyllaceæ (p. **153**).

54. Geranium Family.

Herbs or undershrubs, rarely trees, with *simple or compound, stipulate, often palminerved* leaves. Fls. regular or somewhat zygomorphous or spurred. *Pet.* 5, *usually alternating with glands. St.* 10 (in our genera), *outermost opposite the petals. Ovary* 3–5-*lobed or -celled,* with 1–2 or 2–many *ovules* in each cell *pendulous. Fruit* capsular or *of beaked cocci* adnate for their whole length to a central column from which they separate when ripe, *or baccate with the berry 5-ridged.* Embryo often green in albumen......*Geraniaceæ* (p. **155**).

55. The Balsam Family.

Herbs with simple *exstipulate penninerved leaves* and usually showy *ebracteate zygomorphic flowers. Sep.* 3 rarely 5, imbricate, *large posterior differing from the others, petaloid and spurred.* Pet. 5 or with two pairs connate. St. 5 with short broad filaments and *connate anthers hooded over the stigma. Ovary* 5-celled, *often lobed.* Ovules pendulous axile, raphe dorsal. *Fruit a succulent capsule* with the valves elastically opening upwards. Albumen 0.
Balsaminaceæ (p. **157**).

Sub-order RUTALES (p. 114).

56. The Orange Family.

Trees or shrubs abounding in oil-glands which usually render the *leaves copiously translucent-dotted,* rarely glands only marginal. Leaves simple or usually 1-foliolate or pinnate, alt. or opposite, exstipulate. Pet. 4–5, rarely fewer or (some *Aurantieæ*) more. *St. hypogynous, diplostemonous or many, inserted around a crenate or lobed sometimes elongate disc. Ovary* entire or lobed, 4–5-celled (1-celled in *Feronia*) *or more-celled* (several *Aurantieæ*). *Ovules usually* 2, rarely 1 or more than 2 in each cell. *Fruit* various, rarely splitting into cocci, *usually a copiously glandular berry.* Seeds never winged. Albumen 0 (*Aurantieæ*) or fleshy.........................*Rutaceæ* (p. 158).

57. The Mahogany and Toon Family.

Woody plants without translucent glands (exc. *Chloroxylon*). *Leaves* alt. *usually pinnate, exstipulate. Fls. regular,* mostly in axillary panicles. *Sepals* 3–6 often connate. Petals as many, often cohering. *St.* 4–12, *usually diplostemonous, more or less united* (exc. in the tribe *Cedreleæ*) into a petaloid tube outside the disc. *Disc frequently tubular. Ovary* 2–5- *rarely* 6-*celled.* Ovules 2 or many in each cell, rarely solitary. Seeds sometimes arilled or winged. Albumen thin or absent.........................*Meliaceæ* (p. 172).

58. The Bitter-bark Family.

Woody with bitter bark and alternate usually large *odd-pinnate leaves.* Stipules 0 or deciduous. *Fls. small,* 3–5-*merous,* often polygamous. Sep. connate below, deciduous. *Pet. valvate. Disc simple or lobed. St.* 10, sometimes 2–3 only in the herm. fl. *Ovary deeply* 2–5-*lobed. Ovule* 1 *in each cell. Fruit of* as many *samaras* as fertile lobes of the ovary.........................*Simarubaceæ* (p. 168).

59. The Myrrh Family.

Trees or shrubs often secreting fragrant oleo-resins in the bast or cortex. *Leaves* alternate *odd-pinnate* or reduced to three leaflets of which the lateral may become nearly or quite obsolete. *Fls.* often polygamous. *Sep.* 3–6, often minute, *connate below.* Pet. 3–6. *St. inserted on the margin of or underneath the disc, free.* Ovary usually 3-, sometimes 2–5-celled. *Ovules* 2 *in each cell,* axile, pendulous. *Fruit* drupaceous, sometimes nearly dry, *with usually* 3 (1–5) *free or united* 1-*seeded pyrenes.* Albumen 0. *Cotyledons* usually *twisted plicate or crumpled*.........................*Burseraceæ* (p. 170).

60. The Mango Family.

Woody plants with *resin canals and tannin sacs* in the bast and often other parts. Leaves alternate (rarely opposite in *Nothopegia*), simple 3-foliolate or odd-pinnate with frequently strong secondary nerves. *Fls.* polygamous, *small,* usually 3–5-merous, perfect stamens sometimes few (1 in some *Mangifera*). Calyx sometimes sub-perigynous, usually from a shallow hypanthium *lined with a disc free at the margins.* Stamens inserted near the margin of, or on, the disc. *Ovary of* 1 *or*

3–6 *free or more or less connate carpels, with* 1 *ovule* in *each carpel or ovary-cell,* pendulous, either from an ascending basal funicle or lateral or sub-apical *with dorsal raphe.* Fruit usually a 1-*celled* and 1-*seeded often oblique drupe.* Embryo large and fleshy, often curved.

Anacardiaceæ (p. **219**).

Exceptions :—Drupe several-celled in *Spondias.*

The *Anacardiaceæ* are usually placed in the *Sapindales.* They differ from the rest of the *Geraniales* in the inferior micropyle and dorsal *raphe* and from the *Burseraceæ* in the solitary ovule and mostly 1-seeded oblique drupe. Although both families have resin-canals in the bast and sometimes in the pith and cortex the *Burseraceæ* usually contain a bland fragrant balsam, gummy in appearance; in the *Anacardiaceæ* the contents are usually acrid* and often milky in appearance though sometimes gummy.

Order XII. SAPINDALES.

Woody, very rarely (*Cardiospermum, Polygalaceæ*) herbaceous *with simple or compound exstipulate,* very rarely stipulate, alternate or opposite leaves. *Fls. usually small* and *more or less reduced or irregular* in one or more of the whorls, *often polygamous.* Corolla sometimes 0 or *if perianth regular and complete then stamens usually declinate* or fewer than diplostemonous, *very commonly* 8. *Disc often unilateral and outside the stamens. Ovary commonly* 3-*celled* or sometimes only 2-celled, *very often lobed. Ovule* 1–2 *in each cell,* usually axile or pendulous from the inner angle. Raphe usually dorsal. Fruit often samaroid. Albumen usually 0. *Embryo often curved or spiral.*

Exceptions :—

Disc 0 or inconspicuous in *Polygalaceæ* and *Malpighiaceæ* (which are often included in separate orders or placed in the *Geraniales*) and in male flower of *Dodonæa.*

Flowers regular with diplostemonous stamens in some *Malpighiaceæ,* but then ovary 3-celled and fruit of 3 samaras.

Stamens outside the disc in herm. fl. of *Dodonæa.*

Ovules several in each cell in some *Staphylleaceæ.*

Families: 61. *Malpighiaceæ ;* 62. *Polygalaceæ ;* 63. *Sapindaceæ ;* 64. *Staphylleaceæ ;* 65. *Sabiaceæ.*

61. The Malpighia Family.

Shrubs, *mostly sarmentose or scandent* by means of the (first erect then) spreading or reflexed *opposite leaves,* sometimes twining, or erect (outside our area). *L. simple entire.* Fls. regular or irregular, 2–1-sexual. Sep. 5 with a gland at the base of one or all. *Pet.* 5 *long-clawed, the fifth often different. St. diplostemonous,* hypogynous or sub-perigynous, *often declinate* or 1 *or more sometimes larger. Carpels generally* 3, *connate into a* 3-*celled, sometimes deeply lobed or angled ovary. Ovule* 1 *in each cell pendulous* with often long ascending and curved funicle, raphe ventral and micropyle superior. *Fruit of* 1–3 *winged samaras.* Embryo curved, circinate or straight.

Malpighiaceæ (p. **151**).

* The extremely acrid juice of some species is however often found in special superficial cells, perhaps these are the tannin-sacs of *Solereder* (*Anatomy of the Dicotyledons*), and are often found in leaves and pericarp.

62. The Milkwort Family.*

Herbs, rarely woody with *alt. simple leaves. Fls. irregular*, clustered or racemose, bracteate. *Sepals* 5 free, imbricate, *of which 2 inner are often large and petaloid*, sometimes all petaloid. *Petals 5 or 3 of which anterior* (*keel*) *is usually modified. St.* 8 *or sometimes* 4–5, combined into a split tube or free, *anthers mostly 1-celled* and opening by a pore. *Ovary compressed 2-celled.* Ovules 1 pendulous in each cell. Fruit mostly a 2-celled thin capsule. *Seeds with a strophiole.* Albumen abundant..*Polygalaceæ* (p. 40).

63. The Soap-nut Family.

Woody plants, rarely (*Cardiospermum*) climbing herbs, with *alt. pinnate* or rarely only 1–3-foliolate leaves. Fls. small or medium, usually polygamous and *more or less irregular*, rarely quite regular. *Calyx* 4–8-*lobed or -sepalous. Petals* as many as *or fewer than the sep. or* 0, often *bearded or squamate at the base. Stamens usually* 8 (4–10), often *unilateral* and inserted inside, rarely outside, an annular or *unilateral often lobed disc*, which is sometimes absent in one of the sexes. Ovary entire *or lobed*, sometimes *excentric*, usually 3-*celled*. Ovules 1 rarely 2 in each cell. Fruit entire 1-lobed or winged. *Seeds often arillate*, albumen 0. *Embryo usually with curved or convolute cotyledons*..................................*Sapindaceæ* (p. 210).

64. The Staphylea Family.

Differs from the *Sapindaceæ* by the 5 *stamens only, inserted outside the disc opp. the sepals.* Ovary of 3 carpels free or connate, styles 3 short. *Ovules 2 or more in each cell.* Fruit baccate or of 3 dehiscent carpels.......................................*Staphyleaceæ* (p. 209).

65. The Meliosma Family.

Woody, sometimes scandent, with alt. simple or odd-pinnate leaves. Fls. small, with 5–3 *sepals and petals*, often 2 *petals reduced to scales.* St. *as many as the petals and opposite to them* but *frequently only 2 fertile* and the others modified, inserted on or at the base of the disc. *Ovary* superior free, 2- *rarely* 3-*celled*, sometimes 2-lobed. *Ovules* 2, *rarely* 1, in each cell, axile, superposed. Fruit *drupaceous* and 1-*seeded* or of 2–3 *drupels.* Albumen 0, cotyledons conduplicate with long often spiral hypocotyl.......................................*Sabiaceæ* (p. 217).

Order XIII. CELASTRALES.

Woody plants with *simple* alt. or opposite *leaves, often stipulate.* Flowers small *regular* mostly 4–5-merous. Petals sometimes connate below, usually imbricate, rarely 0. *Stamens isomerous and alternate with or sometimes fewer than the petals usually inserted on a well-developed disc*, and *hence often perigynous* and sometimes enclosing the ovary. *Ovary* 2–5- *often* 3-*celled* with 1–2 *erect or ascending ovules* axile in each cell. Style short or 0. Seed albuminous or not.

* The English name and the scientific name (derived from the Greek meaning *much milk*) is due to its supposed virtue as a lactagogue, not from its having any milky juice.

Exceptions :—

The *Icacinaceæ* have a feebly developed disc and sometimes valvate petals; moreover 5 staminodes sometimes occur opposite the petals and ovules pendulous, so that it is as near the *Rhamnales* and *Olacales* as to *Celastrales*. The ovary is apparently 1-celled by suppression of the other two cells.

Ovary 3–16-celled in *Ilicaceæ*. Ovary with many cells in *Siphonodon* and these irregularly disposed.

Ovules 2–10 in each cell in *Hippocrataceæ*.

Disc 0 or confluent with the ovary in *Ilicaceæ*.

Families: 66. *Celastraceæ;* 67. *Hippocrataceæ;* 68. *Ilicaceæ;* 69. *Icacinaceæ*.

N.B.—The *Salvadoraceæ* are included in this alliance by Hutchinson, but see remarks under *Gamopetalæ* (p. 132) and *Oleales* (p. 135).

66. The Spindle-tree Family.

Often thorny, sometimes scandent. Leaves opp. or alt. usually with small stipules. Fls. usually cymose, 2–1-sexual. Sep. small 4-5 often connate. *Disc well-developed. St. inserted on or under the outer margin of the disc. Ovary* free or immersed in the disc, rarely half-inferior, 2–5-*celled. Ovules* 2 *in each cell* erect from the axis. Fruit capsular, drupaceous or baccate. *Seeds mostly arillate.* Embryo axile with large usually green cotyledons and short radicle. *Celastraceæ* (p. **186**).

Exceptions :—

Siphonodon is an anomalous genus, with numerous irregularly disposed cells and 1 pendulous ovule in each cell.

67. The Hippocratea Family.

Woody, *usually climbing or sarmentose* with simple opp. rarely alt. leaves. Stipules small caducous or 0. *Fls. small or very small, clustered or cymose. Disc usually very large,* sometimes concealing the ovary. *St.* 3 (rarely 2 or 4) *with flattened filaments, inserted on the inner side of the disc* and sometimes appearing as though on the ovary. *Ovary* on or sunk in the disc, 3-*celled* with 3-lobed stigma. *Ovules* 2-10 in each cell, anatropous. Fruit of three compressed almost free dry carpels or samaras, or baccate. Seeds winged or not. *Albumen* 0. Cotyledons large, often connate or fused. . .*Hippocrataceæ* (p. **190**).

68. The Holly Family.

Leaves *alternate* usually coriaceous. Stipules minute or 0. *Fls. usually diœcious or polygamous,* in *axillary cymes or fascicles. Calyx* 3-6-*partite* or lobed, persistent. Pet. 4–5, rarely 6–8, connate at the base or free in the fem. *St.* usually adhering to base of corolla or free hypogynous. Disc 0. *Ovary* 3–16-*celled*, style short or 0. *Ovules* 1–2 *collateral* and *pendulous* with dorsal raphe and superior micropyle, funicle often cupular. *Fruit* a *drupe* with 1-*seeded pyrenes*. Albumen fleshy, embryo minute. . . . . *Ilicaceæ* (p. **185**).

69. The Icacina Family.

Woody or softly woody plants, often climbing, with alt. very rarely opp. leaves (palminerved in our species) exstipulate. *Fls.* 1–2-sexual, mono- or dichlamydeous. *Calyx small hypogynous,* 4–5-*merous,*

imbricate, *not enlarging in fruit*. *Pet.* 5 rarely 4 or 0, free or connate, valvate or slightly imbricate. St. *alternating with the pet., inserted inside the* small *disc*, or disc 0, anthers 4-celled. *Carpels usually* 3, rarely 2 or 5 united into an incompletely 3- or 5-celled ovary, *each cell with* 2 *ovules* but through early abortion becoming 1-celled. *Ovules at the apex of the cell pendulous* anatropous, never on a free placenta, funicle usually thickened above the micropyle, raphe dorsal. Fruit drupaceous, always 1-celled and 1-*seeded*. Seed with thin coriaceous testa, usually albuminous....................*Icacinaceæ* (p. 181).

NOTE.—Some of the italicized characters above are for discrimination from the *Olacaceæ* sometimes united with this family.

Order XIV. RHAMNALES.

Woody plants or herbaceous climbers closely allied to the *Celastrales* with *alternate* simple or *sometimes digitate or pinnate* (*Vitaceæ*) often palminerved *leaves* with or without stipules. Flowers small, mostly similar to the *Celastrales* but *stamens opposite to the petals* and often connate into a tube. *Petals valvate sometimes very minute or* 0. *Ovary frequently* 3-*celled, sometimes quite inferior*. Ovules 1–2 in each cell.

Exceptions :—

Ovary sometimes 6-celled in *Leea*. Some erect species of *Leea* are herbaceous, but with woody rootstock.

L. opp. or sub-opp. in *Scutia*.

Families : 70. *Rhamnaceæ* ; 71. *Ampelidaceæ* (*Vitaceæ*).

70. The Buckthorn and Jujube Family.

Woody plants, sometimes scandent by *reflexed prickles or by tendrils*, rarely by their coiled twigs (as in *Hippocrataceæ*). *Leaves simple*, frequently with several (3–5) principal nerves or strongly penninerved. Stipules changed into prickles or small and deciduous. *Fls.* usually cymose. *Calyx with* 4–5 *triangular valvate lobes* often perigynous, more rarely epigynous. *Pet. smaller sometimes minute* and often concealing *the minute stamens* which stand opposite to them, *under or on the margin of the disc*. Ovary free or united with the hypanthium and half-inferior or (Tribe *Gouanieæ*) inferior, 3-2- (rarely 4-) *celled* with 1 *basal erect ovule in each cell*. Frt. 1-celled and 1-seeded (samaroid in *Ventilago*) or with a 2–4-celled endocarp or 3-valved, sometimes 3-winged. Seed with fleshy, rarely 0 albumen and large erect embryo. *Rhamnaceæ* (p. 192).

71. The Vine Family.

Herbs or soft-wooded shrubs, climbing by tendrils, or erect with stems jointed at the nodes. L. *simple palmately-nerved, digitate, or pinnately compound*. *Fls. in umbels or panicles*, hypogynous or perigynous; calyx sometimes truncate; *pet. valvate* sometimes calyptrate. St. free or at base of the petals, or sometimes connate into a tube, on or outside the disc which is sometimes tubular. *Ovary free or sunk in the disc*, 2–*more rarely* 3–6-*celled*, with 2 *collateral ovules in each cell*........................ *Vitaceæ* or *Ampelidaceæ* (p. 199).

Order XV. UMBELLALES.

(——→ *Rubiales* and *Asterales* ?)

Woody or herbaceous. *Leaves* alternate mostly *compound, if simple then very often with palmate venation. Flowers mostly in umbelliform cymes,* small, regular or outermost in an umbel radiant, *with valvate petals,* 4–5-merous with *isomerous stamens alternating with the petals, calyx often much reduced or* 0. *Disc epigynous. Ovary completely inferior of* 2–5 (*very commonly* 2) *carpels and as many cells,* or ovary many-celled in some *Araliaceæ.* Styles usually free. *Ovule* 1, *pendulous in each cell,* anatropous, raphe ventral, micropyle exterior. Embryo in albumen.

Exceptions :—

Stamens many in the exotic genus *Tupidanthus* (sometimes cultivated).

Families : 72. *Araliaceæ ;* 73. *Umbelliferæ.*

72. The Ivy and Panax Family.

Woody, often scarcely branched, sometimes scandent by adventitious roots, frequently prickly. Leaves *usually palmately compound* or 1-*more-pinnate.* Stipules adnate to the petiolar sheath or 0. *Fls. in dense umbels* which are usually racemed or panicled. *Petals* 5 or 6–7 or more, *inserted with the stamens round or under the margin of an epigynous disc.* St. alt. with the petals. *Ovary 2–many-celled. Fruit coriaceous or drupaceous* with 1 or more ovarian cells usually suppressed. Albumen uniform or ruminate. Embryo minute.

Araliaceæ (p. **414**).

Exceptions :—

St. many in *Tupidanthus.*

73. The Carrot and Parsnip Family.

Herbs with compound (simple in *Bupleurum* and *Hydrocotyle*) and *often much dissected leaves with a sheathing petiole,* exstipulate, rarely stipulate. *Fls. in simple or compound umbels or heads* mostly 2-sexual. *Petals* 5 *inserted under the large epigynous disc. St.* 5 *alt. with the petals.* Disc usually tumid and 2-lobed and surrounding the base of the styles. *Ovary 2-celled. Fruit 2-coccous,* usually ridged or sulcate and *with oil-canals in the pericarp.* Seed 1 in each coccus or mericarp. Embryo small in copious albumen, radicle superior, cotyledons linear............................*Umbelliferæ* (p. **404**).

Order XVI. ALANGIALES.

Small trees or shrubs with alternate leaves often triple-nerved and dotted, simple, exstipulate. Flowers regular, small or medium. *Calyx superior,* toothed or truncate, sometimes accrescent in fruit. *Petals* 4–10 *valvate,* free or cohering at the base. *Stamens opposite to and sometimes adnate to the petals, as many or* 2–6 *times as many, with narrow elongate anthers, inserted on the top of the hypanthium with the petals and outside an epigynous disc. Ovary* inferior 1-*celled, or* 2–3-*celled at the base. Ovule* 1 *pendulous or* 1 *pendulous into each partial*

cell, with laterally placed micropyle. Fruit a drupe. Seed with embryo the whole length of the fleshy albumen which is sometimes ruminate, cotyledons leafy.

Family 74. *Alangiaceæ* (*Cornaceæ* in the *Flora*, from which it should perhaps be separated).

74. The Alangium Family.

Leaves entire or lobed often palmately nerved, sometimes translucent dotted (due to clustered crystals of oxalate of lime). Flowers usually white, in axillary fascicles, or cymes. Calyx usually feebly developed, annular, or with 4–10 teeth. Pet. 4–10 linear or lanceolate. Cotyledons foliaceous palmately-nerved, thin with cordate base and long terete radicle............*Cornaceæ* (Tribe *Alangioideæ*) (p. 417).

Order XVII. OLACALES.

Shrubs or undershrubs, often root parasites with green *alt. simple exstipulate leaves. Flowers regular*, small or medium. *Calyx* (or calyculus, cp. *Santalales*) *minute and sometimes toothed or a rim which becomes accrescent in fruit or* 0. Petals 3–6 valvate (exceptionally imbricate), free or connate. *Stamens opposite to or opposite the edges of the petals*, as many or 2–3 *times as many*, some often unfertile. *Ovary free or enclosed in the accrescent calyculus*, 1-*celled* or 2–5-*celled below* and 1-celled above. *Ovules* 1 *pendulous from the apex of the cell or* if more then on the free part of the incomplete axis and *one pendulous into each partial cell.* Fruit drupaceous, 1-seeded with the placenta embedded in the side of the seed (as in some *Cornaceæ*). Embryo small in albumen.

Family : 75. *Olacaceæ*.

75. The Olax Family.

Characters as above..........................*Olacaceæ* (p. 182).

Order XVIII. SANTALALES.

Shrubs or undershrubs, more rarely herbs, *mostly hemi-parasites with simple opp. or alt. exstipulate leaves*, or rarely *leaves absent* but branches green or (*Balanophora*) a colourless leafless parasite. *Flowers* regular or irregular, 2–1-sexual, small or showy, green or colourless, *haplochlamydeous* or sometimes with a small outer calyculus (or calyx) of small teeth. *Tepals* 2–6 *in one or two whorls*, free or connate. *Stamens opposite the tepals*, isomerous, free or adnate to the tepal. *Ovary inferior*, 1-*celled* (rarely 3-celled in *Balanophoraceæ*). *Ovules* 1–3 *pendulous from a free central placenta* or *placenta fused with the ovary* or (*Balanophoraceæ*) 1 in each cell pendulous from the top. Fruit drupaceous or baccate or (*Balanophora*) minute and crustaceous. Seed often adherent to the pericarp. Embryo sometimes minute and undivided. Albumen present.

Exceptions :—

Perianth sometimes 0 and stamens sometimes connate into a cenrtal mass in *Balanophoraceæ*. The *Balanophoraceæ* are fleshy leafless root parasites often

without perianth in one or both sexes and flowers crowded in a spadix-like peduncle. *They are very doubtfully allied to the other families.*

Families: 76. *Santalaceæ;* 77. *Loranthaceæ;* 78. *Balanophoraceæ.*

76. The Sandal-wood Family.

Woody or herbaceous (very slender in *Thesium*), often hemiparasites. *Leaves entire, sometimes scale-like,* nerves inconspicuous. *Flowers small regular, 1–2-sexual. Perianth perigynous or epigynous, 3–8-merous,* lobes frequently with a tuft of hair behind the anthers. *Stamens adnate to them,* rarely at the base of the perianth. *Disc perigynous or epigynous. Ovary* nearly free or adnate to the hypanthium, 1-*celled,* stigma entire or 3–6-lobed. *Ovules* 2–3, *adnate* to or pendulous from a central column. Fruit a drupe or nut. Seed globose or ovoid, testa thin or obsolete, *albumen copious. Embryo usually terete*............................*Santalaceæ* (p. **804**).

77. The Mistletoe Family.

Green parasitic shrubs attaching themselves by means of haustoria to the branches of their hosts. *Leaves simple entire,* sometimes reduced to scales. *Flowers* regular or zygomorphic, 1–2-*sexual,* usually bracteate and often 2-bracteolate. *Hypanthium adnate to the ovary* and sometimes growing up as an entire or toothed ring or "calyculus" above it. *Perianth* sepaloid or petaloid of 4–6 *tepals* free or connate into a tube below, *valvate* in bud. *St.* usually adnate to the tepals. *Ovary inferior* 1-*celled,* stigma simple. *Ovule and placenta not differentiated,* completely filling the ovary, with usually 1, rarely 2–3 embryo-sacs. Fruit baccate, rarley drupaceous, with a viscid inner layer (by means of which it becomes attached to the future host).
Loranthaceæ (p. **801**).

78. The Balanophora Family.

Fleshy brownish or yellowish root parasites with *leaves* 0 or reduced to scales; stomata absent. *Flowers monœcious or diœcious, small or minute,* crowded on spadix-like peduncled globose or elongate heads with very stout peduncles arising from a tuberous simple or branching rootstock. *Male perianth* of 3–8 *valvate tepals or* 0, *stamens isomerous and opp. the tepals* or *connate in a central mass,* or in the naked flowers 1–2 only, *anthers 2–many-celled,* opening by slits, pores or irregularly. *Fem. per. much smaller,* minutely toothed and confluent with the ovary or altogether absent. *Ovary* 1–3-*celled. Ovule* 1 *in each cell,* pendulous, naked or with a single integument or reduced to an embryo-sac. *Fruit minute* 1-*seeded,* the *seed adherent to the pericarp,* albuminous. *Embryo* minute, *undifferentiated.* Alliance very doubtful..................*Balanophoraceæ* (p. **806**).

Order XIX. ELÆAGNALES.

Trees or shrubs *often with silvery scales* or rarely stellate indumentum. *Leaves* alt. or opposite, *entire, faintly penninerved.* Flowers spiked or racemose or at the nodes, 1–2-sexual. *Perianth haplochlamydeous* tubular 2–4-*lobed* or *rarely truncate,* in the fertile flower *constricted*

above the ovary and upper part deciduous. *Stamens* in 2-sexual flowers *perigynous*, in male fls. at the base of the perianth, either 4 *alternate with the lobes, or* 4 *opposite to the lobes* and *also* 4 *alt. with them*, filaments free. *Ovary* sessile in the base of the perianth, 1-*celled*, style terminal, stigmatose on one side. *Ovule* 1 *erect from the base, anatropous.* Fruit nut-like, but enclosing perianth sometimes fleshy. Albumen scanty. Embryo straight with fleshy cotyledons, radicle inferior.

Family: 79. *Elæagnaceæ.*

79. The Oleaster Family.

Characters as above........................*Elæagnaceæ* (p. 800).

Order XX. PROTEALES.

Woody plants with alternate simple or compound exstipulate *leaves of hard texture. Flowers* cyclic, *haplochlamydeous,* regular or zygomorphic, often showy, 2-*sexual, mostly* 4-*merous* (except in the gynæceum), *with the stamens opposite and adnate to and often sessile on the perianth lobes. Perianth* inferior, *segments at first valvately cohering into a cylindrical tube gibbous at the base,* finally free recurved. Hypogynous glands or scales often alternating with the stamens. *Ovary apparently of* 1 *carpel only,* 1-*celled,* often on a gynophore and oblique, *style terminal with thickened tip,* stigma sometimes lateral. Ovules 1 to several and 2-seriate. *Fruit nut-like or capsular.* Seed exalbuminous, cotyledons often unequal.

Position altogether doubtful. Engler places them near *Urticales,* Warming near the *Elæagnales* and *Thymelæaceæ,* and he also mentions relationship with the *Leguminosæ.* Lindley places them in his *Daphnales* (which includes Laurels), and Hutchinson also thinks them allied to *Thymelæaceæ* which he considers allied to his *Lythrales.* They are a large group in the dry regions of Australia and the Cape.

Family: 80. *Proteaceæ.*

80. The Grevillea Family.

Characters as above...........................*Proteaceæ* (p. 799).

Order XXI. ROSALES.

(*Ranales* ←—).

Herbaceous or woody with simple or compound leaves *often with sheathing bases* (as in *Ranales*) or adnate stipules or stipules free or 0. *Flowers* regular large to small (much reduced in *Podostemonaceæ*), *cyclic or sometimes hemicyclic, perigynous to epigynous,* if hypogynous then *hypanthium lined by a disc bearing the stamens, heterochlamydeous, petals free,* rarely petals united or 0. *Stamens very many* to definite and few. *Ovary apocarpous of* 2 to many carpels or *more or less syncarpous,* but then styles usually free. Ovules 1 to many in each carpel, when ovary syncarpous then placentæ often much swollen,

placentation usually axile or on ventral suture of carpels or ovules pendulous. Fruit very various, sometimes of achenes or follicles.

Exceptions :—

Corolla gamopetalous in our species of *Crassulaceæ*.
Carpel 1 only in *Prunus* and *Pygeum* and then ovules 2 pendulous.
Ovary 1-celled with 2 pendulous placentæ with several ovules in *Vahlia*.
Ovules parietal in some *Droseraceæ*. The *Podostemonaceæ* are moss-like aquatics and their systematic position is extremely problematical; the flowers are naked or 3-merous in our species (see description of family) and hypogynous.

N.B.—Some of the *Rosales* (in the broad sense here adopted) appear closely allied to the *Ranales*, but most families are highly evolved and depart widely from them. Hutchinson places *Rosales* widely apart from *Saxifragales* (emend.), but puts near to them the *Cunoniales* (which includes the woody *Saxifragaceæ* of most authors). With these *Cunoniales-Rosales* phyla he places the *Hamamelidales* (also placed in *Rosales* by Engler), from which phylum he considers is derived the *Amentiferæ*. Some of the *Hamamelidaceæ* do indeed show a remarkable resemblance to the *Amentiferæ*, *e. g.* the giant *Tetrameles* which occurs in the foothills of the Himalayas not far from our area. Another alternative alliance of the *Amentiferæ* appears to be some of the *Euphorbiaceæ* and *Urticaceæ*, or again an independent phylum derived from a Gnetaceous stock. The anatomy on the whole rather favours the second alliance, but here the *Salicaceæ* are considered with Hutchinson to be allied to the Hamamelidaceous stock. As no *Hamamelidales* occur in our area the *Salicales* appear to follow on very unnaturally.

Sub-order ROSALES proper.

Herbaceous to woody. Fls. mostly 2-sexual. Leaves alternate. Albumen scanty or 0. Embryo large.

Family: 81. *Rosaceæ*.

Sub-order SAXIFRAGINEÆ.

Usually herbaceous and scapigerous or leaves exstipulate. Fls. 2-sexual. Ovary 1–3-celled or apocarpous. Stamens definite isostemonous or diplostemonous. Albumen copious, embryo small, straight.

Families : 82. *Saxifragaceæ* (*sensu stricto*) ; 83. *Crassulaceæ*.

Sub-order CUNONIALES.

To this Hutchinson assigns the woody *Escallonieæ*, *Hydrangeæ*, etc., placed by Hooker & Bentham in the *Saxifragaceæ*. Only cultivated members occur in our area.

Sub-order DROSERINEÆ.

Family : 84. *Droseraceæ* (*q. v.*).

These are sometimes placed in the *Parietales* alliance.

Sub-order PODESTEMONINEÆ.

Family : 85. *Podestemonaceæ* (*q. v.*).

81. The Rose Family.

Woody or herbaceous with *stipulate alternate* simple or variously compound *leaves*. *Fls.* sometimes small, usually medium or large, *regular, perigynous or epigynous or nearly hypogynous*, cyclic or carpels sometimes acyclic. Calyx with 5–10 usually imbricate sepals, *the odd sepal superior* (*dorsal*). *Petals free*, usually 5. *Stamens on the disc*

lining the hypanthium, usually *many*, often incurved or circinate in bud. *Ovary with 5–many free carpels* (apocarpous) or *carpels more or less connate and adnate to the hypanthium*, rarely only 1. *Styles mostly free*. Ovules 1–2 or several. Fruit of achenes, drupels, a drupe or a pome, sometimes achenes free but included inside the fleshy hypanthium which becomes part of the fruit............*Rosaceæ* (p. 336).

82. The Saxifrage Family (restricted to the herbaceous genera).

Herbs, often growing in patches. Leaves alternate (rarely opposite) entire or palmately divided. Stipules 0 or adnate to the often dilated petiole. *Flowers* small or very small or medium, *cymose and often scapose or axillary*. *Sep., pet. and st. usually on a disc lining the more or less perigynous or epigynous hypanthium*, sometimes almost hypogynous. *St. definite*, 5 *or* 10, *rarely* 4 *or* 8, isostemonous or diplostemonous, connective frequently glandular at the back. *Ovary of* 2–5, *usually* 2, *free or connate or partially free* (at the top) *carpels*, often forming a 1-celled ovary at least below, placentæ ventral or central with *numerous* 2-*seriate ovules*. Fruit a thin 1–2-celled capsule, often with the cells divaricate when ripe. *Seeds* numerous, minute, embryo minute, terete or clavate, albumen copious.
Saxifragaceæ (p. 341).

Saxifrages differ from some closely allied *Rosaceæ* in the definite stamens in never more than 2 whorls, thicker placentation and albuminous seeds.

83. The Life-plant Family.

Succulent herbs, rarely suffruticose, with fleshy simple or pinnatifid or 3-partite alt. or opp. exstipulate leaves. Fls. small or medium or rather large. *Sep. and pet.* 4–5, free or gamophyllous. *St. isostemonous or diplostemonous, hypogynous or adnate to the corolla-tube. Hypogynous scales usually present*, one at the base of each carpel. *Carpels as many as the petals*, rarely only 3, free or connate below, narrowed upwards into *distinct styles or stigmas*. *Ovules many on the ventral sutures of the carpels*. Fruit of many-seeded follicles. Seed albuminous with terete embryo and short cotyledons.
Crassulaceæ (p. 342).

Some exotic genera contain species with 3-merous flowers which then appear very closely allied to the *Ranales* except that the trimery varies to a 4-merous and 5-merous condition and there are frequently hypogynous scales opposite to each carpel; the anthers too are dorsifixed.

84. The Sundew Family.

Small herbs with radical leaves only or cauline leaves whorled or alt. either *copiously covered with long glandular hairs secreting fluids by means of which they catch and digest small animals* or diaphanous and glabrous and then with automatically closing laminæ. *Fls. small regular in scorpioid cymes* on slender scapes or (*Aldrovanda*) solitary on axillary peduncles, 4–5-merous with often reduction in the carpels. *Calyx persistent. Pet. free.* St. isostemonous or in 2 or more isomerous whorls, hypogynous or somewhat perigynous. *Carpels* 2, 3, *or* 5 *connate into a* 1–*more-celled* free or nearly free *ovary* ; *placenta parietal or meeting in the middle, or the ovules on a free central placenta, anatropous. Fruit capsular*.....................*Droseraceæ* (p. 343).

85. The Podostemon Family.

Moss-like or thalloid aquatics growing on rocks in streams. *Leaves when differentiated simple distichous,* generally with a sheath which may be stipular. *Fls.* on a 1–many-fld. scape or dichasial shoot system, sometimes arising from a sheath, *mostly 2-sexual. Perianth of* small ovate or linear *tepals or scales, sometimes 3-merous or* 0. *St.* hypogynous, 1–many (3 *in our species*) *hypogynous or perigynous,* free or connate. *Ovary 1–3-celled with a stout central placenta and very thin septa. Styles* 1–3. *Ovules many anatropous,* axile (in one genus parietal). *Fruit* capsular, *valves* 2–3. Seeds many minute, exalbuminous. Embryo straight, radicle inferior...*Podostemonaceæ* (p. **783**).

Order XXII. LEGUMINOSÆ.

(←— *Rosaceæ.*)

Woody or herbaceous with *alternate stipulate* compound or unifoliolate *rarely simple leaves. Flowers* small to very showy, *usually zygomorphous* (*always so in the gynœceum*), *perigynous,* rarely hypogynous, *with a disc lining the hypanthium.* Calyx with 5 (–4) sepals or lobes, the odd one inferior (ventral), sometimes calyx 2-lipped or sub-entire. *Petals free or ventral pair connate or corolla gamopetalous,* if corolla regular then sepals and petals valvate in bud. Stamens indefinite or definite. *Ovary apocarpous* reduced to 1 *usually elongate declinate carpel* with usually several *ovules in one or two series along the ventral suture. Fruit a legume* (pod) which is *rarely indehiscent.*

Exceptions :—

Ovary short and the legume globose and 1-seeded in a few small herbaceous *Papilionaceæ* and pod septate in several genera.

Families: 86. *Mimosaceæ ;* 87. *Cæsalpiniaceæ ;* 88. *Papilionaceæ.*

86. The Mimosa and Acacia Family.

Trees or shrubs, rarely undershrubs *with 2-pinnate leaves* (main pinnæ sometimes digitately arranged), pinnæ and leaflets sometimes reduced to one pair. *Fls. small regular, 4–5-merous,* conspicuous from being *collected into dense heads or spikes. Calyx and corolla valvate, usually gamophyllous.* St. free or monodelphous, diplostemonous or indefinite and often very numerous............*Mimosaceæ* (p. **318**).

87. The Cassia Family.

Woody plants, rarely herbs *with pinnate or 2-pinnate leaves* (or apparently simple or of 2 connate leaflets in many *Bauhinia*). *Fls.* large or small, *more or less zygomorphic.* Calyx generally 5-merous, sometimes spathaceous, perigynous or nearly hypogynous, *hypanthium short or long. Petals* 5, fewer or 0, *imbricate, not papilionaceous, dorsal* interior in bud and *often different from the others. St. definite,* diplostemonous or usually fewer by reduction, inserted on the hypanthium or disc lining it, rarely connate. Ovary free or somewhat adnate to one side of the hypanthium. Fruit often indehiscent and samaroid.............................*Cæsalpiniaceæ* (p. **300**).

88. The Pea and Bean Family.

Woody or herbaceous with *simple, digitate or pinnate leaves,* and small or large and showy distinctly zygomorphic (*papilionaceous*) flowers. Corolla imbricate *with the dorsal petal* (*standard*) *exterior in bud*, the others petal in pairs, *the lowest pair often connate and forming the "keel." Stamens* 10 *monadelphous or diadelphous* 9 + 1 or 5 + 5, *or the* 10*th altogether absent.* ....*Papilionaceæ* (p. 225).

Exceptions :—

Stamens in *Sophora* free. Logically therefore this genus should be placed at the beginning of the *Papilionaceæ.*

Order XXIII. MYRTALES.

(←— *Rosales.*)

Woody, more rarely herbaceous (very rarely aquatic herbs). *Leaves simple entire* usually opposite or whorled, *frequently gland-dotted, usually exstipulate.* Flowers cyclic heterochlamydeous or rarely apetalous, mostly 4–5-merous and diplostemonous, or polystemonous from branching, regular with an elongated tubular hypanthium or if hypanthium short then completely adnate to the ovary. Calyx valvate more rarely (some *Combretaceæ, Myrtaceæ and Melastomaceæ*) imbricate or open in bud. *Ovary syncarpous 2–many-celled,* rarely 1-celled. *Styles connate. Ovules usually many, axile.* Seeds 1–many. *Albumen* 0.

Exceptions :—

Some *Lythraceæ, Onagraceæ* and *Melastomaceæ* are herbs. *Trapa* is aquatic. *Halorrhagidaceæ* are aquatic herbs with often multifid leaves and much reduced 2–4-merous flowers, 4 short styles and ovules 1 in each cell.

2–4-merous flowers are very common in *Onagraceæ.*

Leaves are alternate in *Lecythidaceæ.* sub-opp. or alt. in some *Combretaceæ* and few *Onagraceæ* and *Lythraceæ.*

Stipules present and interpetiolar in *Rhizophoraceæ.*

Fls. irregular in some *Lythraceæ.*

Perianth perigynous and ovary free in few *Lythraceæ.*

Petals sometimes suppressed in few *Combretaceæ* and few *Lythraceæ.*

Stamens haplostemonous in some *Onagraceæ.*

Ovary 1-celled in *Combretaceæ* and few *Onagraceæ.*

Ovules pendulous and few from the top, or lateral near the top, of ovary in *Combretaceæ.* Ovules pendulous from apex of cells in *Rhizophoraceæ.*

Families: 89. *Myrtaceæ ;* 90. *Lecythidaceæ ;* 91. *Melastomaceæ ;* 92. *Lythraceæ ;* 92a. *Punicaceæ ;* 93. *Onagraceæ ;* 94. *Halorrhagidaceæ ;* 95. *Rhizophoraceæ ;* 96. *Combretaceæ.*

89. The Myrtle and Jamun Family.

Trees or shrubs with *opp.,* very rarely alt., *simple entire leaves* usually evergreen and as well as other parts mostly copiously supplied with lysigenous oil-glands (appearing as translucent dots in the leaves). *Leaves with an intra-marginal nerve. Fls. epigynous* 4–5-merous (rarely petals 0) *with numerous stamens often in* 4–5 *bundles. Ovary 2–many-celled* with axile placentation, rarely 1-celled with basal placentation. *Ovules many,* rarely only 2–1 *but usually only* 1-*few*

developing as seeds. Fruit various, baccate, drupaceous or opening by as many valves as there are cells. Embryo straight or curved.
Myrtaceæ (p. **359**).

90. The Kumb and Hijal Family.

Woody plants (an undershrub in one species) with the characters of *Myrtaceæ* but *the leaves mostly alternate* or clustered at the ends of the branches and *without oil-glands*, often toothed and without a distinct intra-marginal nerve. *Fls. usually large*, 4–6-merous, rarely 2–3-merous. *Andrœcium often elaborately developed with very many stamens.* Fruit a berry, or fibrous, many-seeded, rarely (*Barringtonia*) 1-seeded. ....*Lecythidaceæ* (p. **366**).

91. The Melastoma Family.

Herbs or shrubs, rarely small trees, with *opp. or whorled entire leaves characterized* (exc. *Memecylon*) *by* 3–7 *principal nerves* which reach almost to the apex and usually distinct scalariform secondaries. *Fls.* small or more often showy, regular, or somewhat irregular in the andrœcium, 2-sexual. *Hypanthium usually united by vertical walls to the ovary or adnate. Sep.* 3–6 *or* 0, *pet. as many*, contorted in bud. St. as many or more than the pet. inserted with them on the margin of the hypanthium. *Anthers opening by pores or short slits. Ovary* 3–6-*celled* or (*Memecylon*) 1-celled. *Ovules very many*, axile or free central. Fruit baccate or capsular opening by pores at the top or irregularly breaking up. Albumen 0....*Melastomaceæ* (p. **368**).

Exceptions :—

The *Memecyleæ* with 1-celled ovary, comparatively few ovules, and 1-seeded berry constitute a very distinct sub-family. The fls. are 4-merous as in many true *Melastomeæ*.

92. The Henna Family.

Woody or herbaceous with *often* 4-*angled branches.* Leaves simple entire mostly opposite, sometimes whorled or alt., sometimes dotted. *Fls.* from minute (in some herbs) to very large (in some trees), 2-sexual, regular or irregular, *perigynous*, 3–6-*merous* (sometimes more). *Sep.* 3–6 *valvate*, sometimes with an epicalyx of smaller intermediate. Petals as many or 0. *St. indefinite or definite, perigynous*, sometimes inserted *inside* the hypanthium. *Ovary* 2–6-celled (more in *Sonneratia*) or by early absorption of septa 1-celled *with long simple style. Ovules very many on large axile placentæ.* Fruit membranous, coriaceous or capsular, sometimes 1-celled by absorption of septa. Seeds many, sometimes winged. Embryo straight (exc. *Sonneratia*).
Lythraceæ (p. **373**).

The *Blattiaceæ* (including *Sonneratia*) are sometimes made into a distinct family.

92a. The Pomegranate Family. (Included in *Lythraceæ* in the *Flora.*)

Shrubs closely allied to *Lythraceæ* with *large* 1–5-*nate fls.* terminating the shoots *having a large flask-shaped hypanthium produced considerably beyond the ovary* with 5–7 *persistent sepals* and 5–7 *imbricate and crumpled petals in bud. St. very many covering the whole disc. Ovary*

adnate to the hypanthium, *many-celled, the cells in* 1–3 *concentric more or less superposed whorls,* with the very numerous *ovules axile in some cells, in others parietal*. . . . .*Punicaceæ* (p. 373).

93. The Evening Primrose and Water Chestnut Family.

Herbs, rarely undershrubs, *usually inhabiting wet places* and sometimes aquatic. Leaves opposite or upper alt., rarely all alt. *Fls. regular and typically* 4-*merous throughout,* or sometimes slightly irregular, axillary, spiked or racemed. *Hypanthium often much elongated with* 2–5, *usually* 4, *valvate sepals. Petals alternate with the sep.,* rarely 0. *St. as many as or twice as many* as the sepals, *epigynous. Ovary* adnate to and entirely enclosed by the hypanthium (exc. in *Trapa*), 1–6- or *usually* 4-*celled*; style simple with capitate or 2–4-lobed stigma. *Ovules many axile in each cell* or (*Trapa*) 1 in each cell, pendulous or half ascending. Fruit usually capsular (indehiscent in *Trapa*), many-seeded (1 *in Trapa*). Seeds with little or 0 albumen.
Onagraceæ (p. 380).

Exceptions :—

Trapa sometimes is placed in a separate family, the *Hydrocaryaceæ,* the characters of which will be recognized from the exceptions above.

94. The Milfoil Family (*Myriophyllum* only).

Aquatics with *usually verticillate,* more rarely opp. or alt. *leaves pinnate* with filiform segments or upper, rarely all, simple deeply cut or entire. *Fls. small sessile* or subsessile axillary or running out into spikes with the leaves reduced to bracts, *monœcious or polygamous,* upper male, lower female and intermediate 2-sexual. *Calyx lobes* 4, *rarely* 2, *very small,* superior at times obsolete. *Petals* 4 *or* 2 *often* failing or reduced in the female, in the male and 2-sexual fl. much exceeding the calyx, imbricate, of delicate texture. *Stamens* 2, 4 *or* 8, *epigynous* in the 2-sexual fls., anthers long, 4-angled, basifixed. Disc small or 0. *Ovary* inferior, 4-, *rarely* 2-*celled, styles* 4, very short, plumose. Ovule 1 in each cell, pendulous, anatropous. *Fruit deeply* 2–4-*lobed,* indehiscent or splitting into 4 drupels. Embryo straight, cylindric, surrounded by thin fleshy albumen.
Halorrhagidaceæ (p. 344).

95. The Mangrove Family.

Trees or shrubs, usually littoral and often furnished with pneumatophores or aerial roots ; generally quite glabrous with opp. entire coriaceous leaves and interpetiolar deciduous stipules which enclose the terminal bud and leave prominent stipular scars. *Fls. regular,* 2-sexual, *on* 1–*many fld. axillary peduncles.* Perianth often coriaceous. *Calyx* superior or half-superior 4–14-*sepalous on a cupular or campanulate hypanthium. Pet. as many often* 2-*fid and laciniate.* St. diplostemonous, rarely indefinite, perigynous or epigynous. *Ovary* free or adnate to hypanthium, 2–5-, rarely 1-celled. *Ovules* 2 *pendulous in each cell* or in 1-celled ovaries pendulous from a central placenta, style 1. *Fruit* 1-*seeded indehiscent* or (*Weihea*) tardily dehiscent.
Rhizophoraceæ (p. 345).

96. The Myrabolan Family.

Trees or shrubs, sometimes scandent, rarely undershrubs. Leaves opp. or sometimes sub-opp. rarely all alternate. *Fls.* usually small greenish (showy in some garden genera), capitate, spicate or racemed *with the hypanthium enclosing and constricted above, or produced into a beak beyond, the ovary.* Sep. and pet. 4–5, rarely 6–7, or pet. 0. *St. diplostemonous. Ovary* 1*-celled, inferior with* 2–7 *ovules pendulous from the apex. Fruit* 1*-seeded,* usually drupaceous, *often* 2–5*-angled or winged*.................................*Combretaceæ* (p. **351**).

Order XXIV. SALICALES.

Woody plants with alternate *simple stipulate leaves. Flowers diœcious,* in the axils of the bracts of a spike (catkin), *without perianth,* or perianth perhaps represented by a disciform expansion or glands. *Male flower with* 2 *to many stamens,* without pistillode. *Fem. fl. with superior* 2–3- *rarely* 4*-carpellary ovary*; 1*-celled with parietal placentæ* and *mostly many ovules, stigmas* 2 (–4). *Fruit a* 2- (–3-) *valved capsule,* with very small seeds carrying *a pencil of hairs near the base. Albumen* 0.

Family: 97. *Salicaceæ.*

97. The Willow Family.

Trees or shrubs with *perulate buds. Leaves alt. simple,* stipules deciduous or persistent. *Flowers diœcious* (very rarely otherwise), *in* close bracteate spikes (*catkins*), one much reduced fl. to each bract, bracteoles 0. *Perianth* 0 or perhaps represented by the scales or glands or cupular disc, some of which are usually present. *Stamens* 2 *or more* with free or connate filaments. *Ovary of* 2 *rarely* 3 *connate carpels,* 1*-celled* with *parietal placentation. Ovules* usually many erect *anatropous* on the lower part of the placenta. *Fruit* capsular, 2–4*-valved. Seeds* few or many, small, exalbuminous, *with thin testa and a basilar pencil of hairs.* Embryo straight, cotyledons plano-convex, radicle short inferior........................*Salicaceæ* (p. **839**).

See note p. 125 *re* affinities.

Order XXV. CASUARINALES.

Affinities very doubtful. Ovule with 20 or more embryo-sacs. Only one family.

98. The Casuarina Family.

Woody plants with sulcate *articulate branchlets* and *leaves reduced to subulate scales* connate at the base and forming short sheaths at the nodes. *Flowers very minute, monœcious.* Males in slender terminal spikes formed of numerous whorled bracts adnate to the rhachis, each bract with a pair of lateral bracteoles, and a *flower consisting of* 1–2 *median scarious tepals, stamen* 1 *with large anther. Fem. in heads* with *close whorls of small bracts subtending pairs of very small but accrescent lateral bracteoles* with an *ovary of* 2 *median*

carpels, 2-celled, but posterior cell barren or suppressed, *stigmas 2 very long filiform*. *Ovules* in the fertile cell 2, *orthotropous, basal or sub-basal*. Female inflorescence forming a cone in fruit, *each achene enclosed in the pair of accrescent woody or coriaceous bracteoles which open when the seed is ripe*. Seed with terminal wing, testa fused with wall of achene. *Albumen* 0. Cotyledons flat equal, radical very short superior............................*Casuarinaceæ* (p. 840).

---

236. Series II. GAMOPETALÆ (SYMPETALÆ).

Perianth always cyclic, usually with distinct calyx and corolla. Calyx persistent and often enlarged in fruit, mostly gamosepalous. Corolla with a basal tubular zone on which the petals appear as lobes, or if tube very short or petals free then stamens fewer than the lobes or petals, and often adnate to them and carpels reduced to 4 or 2. Stamens usually adnate to corolla. Carpels often 2 median or oblique. Ovules with one thick integument and a very small nucellus.

Exceptions :—

Corolla with very short or 0 tube in some *Myrsinaceæ*, *Oleales* and *Plumbaginaceæ*. Cor. 0 in fem. fl. *Xanthium*.

Sepals nearly free in some *Sapotaceæ*, *Apocynaceæ*, *Asclepiadaceæ*, *Convolvulaceæ*. Calyx annular or of 8–12 small teeth in *Thunbergia*. Sep. and petals more than 5 in some *Ebenales*, *Jasminum* (*Oleales*), *Cordia* and *Symphorema* (*Verbenaceæ*).

Stamens free from tube in *Plumbago*, some *Ebenaceæ*, some *Oleaceæ*. Stamens several-seriate and many in many *Ebenales*. Carpels 4–9 or more in some *Ebenales* and *Primulales*.

Ovules with 2 integuments occur especially among *Primulales* and *Ebenales*.

237. The Gamopetalæ or Sympetalæ are retained here as one group in accordance with other systematic works, but they are probably derived from several different groups of the Choripetalæ. The *Primulales* are possibly allied to the *Caryophyllales*, the *Ebenales* to the *Theales*, while the *Oleales* appear related to the *Celastrales*, etc., etc. The origin of the *Asterales* and *Rubiales* is probably to be looked for along the line of the *Umbellales*, near which family in fact they are put in the *Genera Plantarum*.

See also gamopetalous families under exceptions to *Choripetalæ*, para. 233.

238. CONSPECTUS OF THE GAMOPETALOUS ORDERS.

I. Pentacyclicæ, or less specialized Sympetalæ :—

Floral whorls normally 5, *i. e.* two whorls of stamens are present, or if only one whorl is developed, then ovary 5-carpellary and usually 1-celled. Flowers regular. Corolla-tube often short or sometimes 0. Ovary mostly superior, usually with more than 2 carpels.

Orders : XXVI. *Primulales* ; XXVII. *Ebenales*.

II. Tetracyclicæ :—

Floral whorls normally 4, *i. e.* only one whorl of stamens is developed. Fls. regular or irregular. Corolla-tube usually distinct. Ovary

superior or inferior. Carpels rarely more than two (some *Polemoniaceæ*, *Caprifoliaceæ*, and *Campanulaceæ*, few *Rubiaceæ* and very few *Convolvulaceæ* and *Verbenaceæ*).

A. Ovary superior :—

1. Flowers regular. Stamens isostemonous, or 2 only in *Oleaceæ*.

Exceptions :—

Flowers slightly zygomorphic in some *Polemoniaceæ*, irregular with fertile stamens fewer than the petals in a few *Gentianaceæ*.

Stamens slightly declinate or flowers somewhat irregular in a few *Solanaceæ* and *Boraginaceæ* but only in cultivated plants in our area.

Orders: XXVIII. *Oleales;* XXIX. *Gentianales;* XXX. *Polemoniales* (including *Solanaceæ*)*;* XXXI. *Boraginales.*

2. Flowers irregular (zygomorphic). Stamens mostly fewer than isostemonous, often didynamous.

Exceptions :—

Corolla sometimes with subequal spreading lobes in a few *Acanthaceæ*, *Labiatæ* and *Verbenaceæ*, regular and 6–12-merous in *Symphorema*.

The family *Solanaceæ* is sometimes included in the *Personales.*

Orders: XXXII. *Personales;* XXXIII. *Lamiales.*

B. Ovary inferior. Flowers regular or irregular:—

Orders: XXXIV. *Rubiales;* XXXV. *Campanales;* XXXVI. *Asterales.*

239. DESCRIPTIONS OF ORDERS AND FAMILIES OF THE GAMOPETALÆ.

Order XXVI. PRIMULALES.

(←—— *Caryophyllales ?*)

Herbs, shrubs or rarely small trees, very often glandular, with *alt. simple* exstipulate *leaves* and *regular* 1–2-sexual flowers. *Stamens opp. to the corolla lobes haplostemonous* or sometimes diplostemonous with a very rudimentary first (alternating) whorl still present, *adnate to the corolla or free. Ovary 1-celled with free central placentation*, superior or half inferior. Ovules sometimes amphitropous. Seed usually albuminous. Embryo straight or curved.

Families: 99. *Plumbaginaceæ;* 100. *Primulaceæ;* 101. *Myrsinaceæ.*

99. The Plumbago Family.

Herbs or shrubs with often fleshy leaves. Fls. capitate, racemed or panicled with the *bracts often scarious and sheathing the calyx, bracteoles* 2. *Calyx* inferior *tubular* 5–10-*ribbed*, mouth frequently funnel-shaped and *scarious or sub-petaloid. Petals free or gamopetalous* with a very short tube, or rarely tube linear. St. 5 opposite the petals and often adnate below to the tube. Disc 0. *Ovary superior, styles* 5 *free or connate*, stigmas sub-capitate. *Ovule* 1 *pendulous from an ascending basal funicle.* Fruit capsular membranous or with hardened apex, rupturing near the base or circumsciss, apex often 5-valved. Seeds cylindric, pendulous, albuminous or not. *Embryo straight.* .... *Plumbaginaceæ* **(p. 504)**

100. The Primrose Family.

Herbs with radical, alt., opp. or whorled leaves. Calyx inferior gamosepalous, usually 5-lobed. *Corolla hypogynous, usually 5-lobed. Stamens on the corolla-tube* sometimes with alternating staminodes. *Ovary with undivided style. Ovules many, usually amphitropous, on a free central placenta. Capsule dehiscing by valves or circumsciss,* few- or many-seeded. Seeds minute, usually angular, often sunk in the placenta. Albumen fleshy or horny. Embryo transverse. *Primulaceæ* (p. 505).

101. The Ardisia Family.

Woody plants often with small red glands, especially on the margins of the leaves, including the floral leaves (schizogenous secretory cavities). Fls. regular 2-sexual or polygamo-diœcious, small or medium-sized. *Calyx* inferior or (*Mæsa*) more or less superior, 4–6-, usually 5-lobed, *persistent*. Petals gamopetalous or rarely free (some *Embelia*), lobes contorted or imbricate. Stamens opposite the petals and more or less adnate to corolla (anthers transversely septate in *Ægiceras*). *Ovary free superior, or half-inferior* (*Mæsa*), style simple, with simple or shortly lobed stigma. Ovules few or many. Fruit baccate or sometimes (*Ægiceras*) finally dehiscent. *Seeds mostly globose and with pitted or ruminate albumen.- Embryo transverse, curved, sometimes sigmoid*...........*Myrsinaceæ* (p. 507).

Order XXVII. EBENALES.

(←—— *Theales*).

Trees or shrubs with simple alt. or (some *Diospyros*) sub-opp. *entire exstipulate leaves.* Sap sometimes milky. *Flowers* medium or small, *regular*, 1–2-sexual. *Corolla rarely with free petals* or nearly free petals, *lobes or petals often more than* 5. *Stamens diplostemonous or in several whorls* or one whorl reduced to staminodes (haplostemonous by abortion). *Ovary* 3–10-*celled. Ovules* 1-*few in each cell*, pendulous or ascending. Albumen sometimes ruminate.

Families: 102. *Styraceæ ;* 103. *Ebenaceæ ;* 104. *Sapotaceæ.*

Exceptions :—

Stipules sometimes occur in *Sapotaceæ*, but are very caducous.

102. The Storax Family.

Woody plants with alt. leaves. *Fls.* 2-sexual or polygamous, in axillary and terminal *simple or compound racemes or spikes. Calyx* perigynous or epigynous, or sometimes inferior, 4–5-*toothed or almost obsolete. Petals* 4–10, usually 5, *sometimes free to the base*, imbricate. *Stamens* 8–10 *or many* with free or connate filaments and more or less adnate to the corolla. *Ovary* 2–5-*celled or septa not reaching apex of the ovary, style slender. Ovules* 1 or few, *mostly* 2 *in each cell, axile,* pendulous or erect. Fruit drupaceous 1-, rarely 2–3-seeded. Seeds albuminous. Embryo straight or curved. ....*Styraceæ* (p. 521).

103. The Mohwa Family.

Trees with *usually milky juice* and *young parts usually rusty tomentose.* Leaves alt., coriaceous. *Fls.* 2-sexual usually (in our species) axillary and clustered, *often from leaf scars ;* bracts and bracteoles 0 or minute. *Calyx* inferior, *lobes* 4–8 *imbricate, or 2-seriate and outer series valvate,* persistent. *Cor.-tube shorter than calyx, petals* 2–4-*times as many as calyx-lobes. St.* on cor.-tube epipetalous, 1–3-*times as many as cor.-lobes* and 1–3-*seriate or some reduced to staminodes. Ovary* sessile 2–8-*celled with simple pointed style. Ovules* 1 *in each cell,* axile. *Fruit baccate* 1–8-*seeded.* Embryo straight with large fleshy cotyledons and exalbuminous, or albuminous with flat cotyledons, radicle inferior. . . . . *Sapotaceæ* (p. **510**).

104. The Ebony Family.

Woody plants without milky juice, with alt., rarely sub-opp. or opp. leaves. *Flowers* regular, 3-merous or 4–5-, rarely 6–7-merous, *usually diœcious. Males in 3–more-flowered cymes. Fem. solitary* or several on abbreviated lateral branches. *Calyx* inferior gamosepalous, *often accrescent or hardened in fruit. Corolla regular. St. inserted* at base of corolla *isomerous, or* 2–3-*times as many as its lobes,* in fem. reduced to staminodes, rarely 0. *Ovary sessile* 2–16-*celled,* with 1–2 *pendulous anatropous ovules in each cell ; styles* 2–8 free or connate at base with small or often flabellate stigmas. Fruit baccate, coriaceous or fleshy with as many cells as in the ovary or fewer by abortion. Seeds compressed, albumen copious often ruminate. Embryo axile, straight or curved, with flat cotyledons and superior radicle.

Ebenaceæ (p. **514**).

Order XXVIII. OLEALES.

(←— *Celastrales.*)

Trees or shrubs *without milky juice,* with simple or pinnate mostly penninerved exstipulate leaves. *Flowers regular* 2-sexual or polygamous. *Calyx small inferior usually* 4– (5–9)-*lobed. Corolla usually* 4 (5–9)-*lobed. Petals sometimes nearly or quite free,* valvate or imbricate. *Stamens* 2 or 4 (*Salvadoraceæ*). *Ovary* 2–1-*celled. Ovules* 1–2 *in each cell, anatropous or amphitropous, pendulous or ascending from the angle of the dissepiment.* Seeds with or without albumen. Embryo straight.

Families : 106. *Oleaceæ ;* 107. *Salvadoraceæ.*

The *Salvadoraceæ* are closely allied to the *Oleaceæ* and possibly to the *Celastraceæ.* They have often *minute stipules,* 4 stamens and a disc (?) of interstaminal glands. They have been shown by Hutchinson under the *Celastrales* (following Baillon), but in that case it would appear better to remove the whole *Oleales.* Sometimes a 3-celled ovary occurs in *Oleaceæ* (*Nyctanthes*) and the petals are sometimes free in *Linociera.*

105. The Olive and Jasmine Family.

Woody plants, rarely undershrubs, with simple or pinnate, usually penninerved exstipulate leaves. Flowers regular mostly in 3-chotomous

cymes or panicles, rarely fascicled or racemed, 2-sexual, polygamous or rarely diœcious. Calyx small. Corolla gamopetalous or tube very short in some genera, lobes or petals usually 4, sometimes 0. *Stamens* 2 on the corolla tube (hypogynous in apetalous species). *Ovary free* 2-*celled*, stigma simple or 2-lobed. *Ovules* 1–2, *rarely* 3–4 *in each cell, axile, near base* and *apex.* Fruit capsular or baccate, dry or drupaceous. Seed 1, or 1 in each cell, albuminous or not. Radicle superior or inferior........................*Oleaceæ* (p. 522).

Exceptions :—

The calyx and corolla are often 5–9-lobed in *Jasminum.* Petals sometimes free in *Linociera.*

106. The Salvadora Family.

Often spinous or with olive-grey foliage. Leaves opp., entire, with minute stipules. Fls. small clustered or panicled, diœcious or polygamo-diœcious. *Calyx inferior* 3–5- *often* 4-*fid.* Corolla gamo- or polypetalous, 4-merous, *petals imbricate. St.* 4, hypogynous or on the cor.-tube, alt. with the petals, sometimes connate by the filaments. Alternating glands or staminodes sometimes present. *Ovary* free, 1–2 *or imperfectly* 4-*celled,* stigma entire or 2-fid. *Ovules* 1–2 *in each cell, erect from the base, anatropous.* Fruit a berry or drupe, mostly 1-seeded. *Seed* erect globose, *exalbuminous*....*Salvadoraceæ* (p. 530).

Order XXIX. GENTIANALES.

Trees, shrubs or herbs, *often with milky sap,* and with *opposite or* 3-*nate simple entire exstipulate often palminerved leaves. Flowers regular* 2-sexual, usually cymose. Calyx and corolla 4–5-merous, *corolla usually contorted in bud. Stamens isomerous,* adnate to the corolla at least at the base, sometimes combined into a column with the pistil. *Carpels* 2 *combined into a* 2- *or* (*Gentianaceæ*) 1-*celled ovary, or distinct except in the styles. Ovules many, parietal or covering a large axile placenta.*

Exceptions :—

Stipules or stipular lines sometimes occur in *Loganiaceæ,* which family is closely allied to the *Rubiaceæ.*

Leaves sometimes toothed in *Buddleia.*

Fls. irregular and stamens fewer than the petals in some *Gentianaceæ.*

Corolla often imbricate or valvate in *Loganiaceæ.*

Ovules only 1–8 in each cell in a few *Apocynaceæ.*

Families : 107. *Gentianaceæ ;* 108. *Loganiaceæ;* 109. *Apocynaceæ;* 110. *Asclepiædaceæ.*

107. The Gentian and Chiretta Family.

Herbs, rarely aquatic, with opp. or occasionally alternate, simple (in our species) leaves. Flowers small or showy, *regular, or irregular especially in the andrœcium,* mostly in ebracteate cymes. Calyx inferior, 4–5-lobed. Corolla funnel-shaped or rotate, *lobes imbricate or twisted to the right. Stamens* on the tube, alt. with the lobes, *sometimes unequal or some suppressed,* anthers dehiscing longitudinally or by apical pores. *Ovary free,* 1-*celled or more or less* 2-*celled* by the

intrusion of the parietal placentæ. Style often short, stigmas 2. *Ovules numerous.* Fruit capsular, often membranous, rarely baccate. *Seeds many small. Albumen copious*............*Gentianaceæ* (p. **566**).

108. The Strychnine Family. (——→ *Rubiales.*)

Woody or herbaceous with opp. leaves often united by a stipulary line or sometimes petioles dilated at the base, more rarely stipules distinct. Fls. cymose, or cymes sometimes reduced to single flowers, sometimes capitate or panicled. *Calyx small inferior 4–5-toothed or -lobed.* Corolla 4–5-lobed or -partite. *Stamens on the tube, alternate with its lobes. Ovary superior free 2-celled with simple style* and capitate 2-fid or 2-partite stigma. Ovules 1 or more in each cell; *placentæ axile or in the inner basal angles,* sometimes peltate. Fruit a septicidal capsule or baccate, 1–many-seeded. Albumen copious, embryo straight..................................*Loganiaceæ* (p. **563**).

109. The Oleander Family.

Woody or herbaceous plants *usually with milky juice* and often twining. Leaves opp. or whorled or (only in introduced species) alt., sometimes with stipular lines and glands. Calyx 5-, rarely 4-lobed. *Corolla* rotate or salver-shaped, rarely campanulate or funnel-shaped, *sometimes with a corona of scales. St.* as many as the cor.-lobes inserted on the tube with short filaments, *anthers often conniving and sometimes adhering by a point on the connective to the swollen top of the style,* but *not forming a column with the style and stigma,* and *pollen granular.* Disc often present. Ovary 2-celled (1-celled in the exotic *Allamanda*), or *usually of 2 distinct carpels united by the style. Ovules 2-many in each carpel,* rarely 1 only. Fruit of free or connate follicles, more rarely a berry or drupe. *Seeds often with a coma of silky hairs,* albuminous or not.........................*Apocynaceæ* (p. **531**).

110. The Asclepias or Mudar Family.

Climbing herbs, rarely erect shrubs, *abounding in milky juice,* rarely (*Sarcostemma*) leafless. In other respects the family *differs from the Apocynaceæ essentially in the pollen, which forms one or two waxy more rarely granular masses* (*pollinia*) *in each anther-cell. Filaments usually connate in a column round the pistil,* rarely (*Periploceæ*) filaments free. The flowers are frequently in umbelliform cymes and fruit of 2 (–1) follicles.........................*Asclepiadaceæ* (p. **546**).

Order XXX. POLEMONIALES.

Climbers or rarely erect, sometimes with milky juice. *Leaves alternate, mostly simple cordate and palminerved,* sometimes palmately compound, rarely pinnate or 0 (*Cuscuta*), exstipulate. *Flowers regular, completely gamopetalous,* with frequently an entire or only slightly lobed limb. *Sepals sometimes free. St.* 5, alt. with lobes of corolla (if any). *Disc usually prominent. Carpels* 2 or rarely 3–5, combined into a *2-celled, rarely* 1- or *3–5-celled ovary.* Style 1, stigmas 2 or styles

very rarely 2 or 3–5. *Ovules 2 collateral erect or many in each carpel*, often amphitropous. Fruit capsular or baccate.

Families: 111. *Hydrophyllaceæ;* 112. *Polemoniaceæ;* 113. *Convolvulaceæ.* The *Solanaceæ* are sometimes included here.

Exceptions:—

Lower leaves sometimes opposite in *Polemoniaceæ.*
Ovary deeply 4-lobed in *Dichondra.*
Flowers slightly irregular in some *Polemoniaceæ.*

111. The Nemophila Family.

Herbs, sometimes glandular-hairy. Leaves simple or pinnate. Sepals shortly connate, imbricate. Corolla usually rotate, lobes imbricate. St. inserted near its base, alt. with the lobes, equal or not, anths. versatile. Disc seldom present. Ovary superior with broad base, 2-*carpellary*, 1–2-celled, *often septum partial* (edges of carpels not meeting in middle), placentæ therefore usually 2 in each cell, one from each of the partial septa, but usually much swollen so as sometimes to meet in the middle. *Ovules many* or *sometimes only 2 to each carpel*, sessile or funicled, anatropous or amphitropous. Fruit capsular, loculicidally 2-valved, or valves separating from the septum. Seeds albuminous. *Embryo small, straight, axile.*
Hydrophyllaceæ (p. 571).

112. The Phlox Family. (——→ *Personales.*)

Woody or herbaceous, sometimes scandent, often glandular. Leaves *simple or pinnate*, lower sometimes opposite. Fls. often showy, regular or somewhat zygomorphous, hermaphrodite, 5-merous, usually cymose (solitary in *Cobœa*). *Calyx* inferior, *gamosepalous.* Corolla gamopetalous, lobes twisted to right. *Stamens* on tube and alt. with its lobes, *often unequal* and *sometimes declinate.* Disc usually prominent. *Ovary mostly* 3-*carpellary* and 3 (–5)-*celled.* Style simple or 3-fid. *Ovules very many, few or solitary* in each cell, axile, more or less amphitropous. *Fruit* capsular, 3-*valved*, sometimes with partial false septa in the middle of the valves. Seeds as many as the ovules, sometimes winged, often with peculiar mucilage-cells in the testa, albumen enclosing the *embryo*, which is *straight and axile with somewhat broad cotyledons*....................*Polemoniaceæ* (p. 572).

113. The Convolvulus Family. (——→ *Boraginaceæ.*)

Herbaceous, rarely shrubby, usually twining to the left, often with milky juice. Leaves mostly simple and palminerved, sometimes palmately divided. Hairs sometimes forked. Fls. solitary or cymose, usually with 2 bracteoles. Sepals 5 free or connate, often unequal, persistent. Corolla rarely deeply lobed, lobes usually induplicate-valvate and whole limb plaited. *Stamens* 5, rarely 4, on the tube. Disc annular, rarely almost obsolete. Ovary 1- or usually 2-celled or by the formation of false septa often 4-celled, *style* terminal, rarely styles 2. *Ovules* 2 *in each carpel, collateral, erect, basal, sessile*, with 1 integument. Fruit capsular or baccate. Seeds 4–1, albumen 0 or scanty. *Embryo curved or spiral with foliaceous plaited cotyledons* which on expansion are *often retuse or 2-lobed*.......*Convolvulaceæ* (p. 582).

Exceptions :—

Cuscuta is a leafless parasite and flowers with infrastaminal scales.
Leaves pinnately divided in *Quamoclit.*
Style from between the lobes of the ovary and fruit of nutlets in *Dichondra*, which connects this family with the *Boraginaceæ.*
Ovary 3-celled in *Pharbitis*, 4-celled in *Argyreia* and *Batatas*, 1-celled in *Hewittia.*

Order XXXI. BORAGINALES.

Woody or herbaceous with *alternate leaves,* often hispid, *not glandular. Leaves simple, alternate,* very rarely lobed, exstipulate. *Inflorescence usually in dichotomous cymes* with the *branches scorpioid* and *flowers unilateral. Flowers* mostly small *regular.* Calyx persistent. Corolla gamopetalous, usually salver-shaped or rotate, 5-, rarely 4- or 6-lobed. *Stamens isomerous,* rarely unequal. Disc often present, hypogynous. *Ovary of* 2 *median carpels, each carpel with* 2 *ovules,* carpels often divided by a secondary septum so that the ovary becomes 4-celled and is then often deeply 4-lobed with a gynobasic style and 1-ovuled loculi. *Ovules erect or oblique from the basal inner angle* of the loculus *with the micropyle superior* or facing the axis (ventral). Fruit drupaceous with 2–4-celled endocarp or splitting into pyrenes or of 4 nutlets. Seed with copious or little albumen or exalbuminous. Embryo straight or curved, *radicle superior.*

The *Boraginaceæ* and *Cordiaceæ* are sometimes united with the *Polemoniales*, sometimes with the *Lamiales.* The fruit of some of them (*Borageæ*) closely resembles that of *Labiatæ*, but there appears to be little else in common. They are more closely allied to the *Hydrophyllaceæ.*

Exceptions :—

Leaves sub-opposite or lower sometimes opposite in *Cordia.*

Families: 113*a. Cordiaceæ;* 114. *Boraginaceæ* (both united in *Boraginaceæ*, p. **572**).

113a. The Sebesten Family.

Woody plants. Leaves sometimes sub-opposite, *often with cystoliths.* Flowers frequently 4–10-merous, but normally 5-merous. Style terminal twice partite or 2-fid (*Ehretia*). Fruit a drupe with 4-celled (or fewer) endocarp. Cotyledons plicate. Albumen 0.

Cordiaceæ, see *Boraginaceæ* (part).

Exceptions :—

Cotyledons ovate, not plicate in *Ehretia*, which is better put into the *Boraginaceæ.* It has a scanty albumen.

114. The Borage and Heliotrope Family.

Usually herbaceous, sometimes fruticose and scandent, *very often with hispid hairs.* Flowers 5-merous, *corolla very often with scales in the throat. Style usually simple,* rarely terminal (*Heliotropieæ*) *but usually from between the lobes of a deeply divided ovary.* Albumen sometimes present..............................*Boraginaceæ* (part) (p. **572**).

Exceptions :—

Styles 2 or 2-fid in *Coldenia.*
Rhabdia is a shrub with few axillary flowers.

Order XXXII. PERSONALES.

(*Polemoniales* ←——.)

Small herbs or shrubs, rarely (*Bignoniaceæ*) trees, occasionally glandular. Leaves alt. or opposite exstipulate simple or more rarely pinnate. *Flowers irregular,* rarely (most *Solanaceæ* and few genera of other families) regular or sub-regular, *not twisted* in bud. Posticous stamen nearly always rudimentary or altogether absent* (*exc. Solanaceæ*), sometimes only 2 stamens perfect. *Ovary 2-celled,* superior, *with many ovules on the axis.* Seeds exalbuminous.

Exceptions :—

Solanaceæ have usually regular flowers but the tribe *Salpiglossidæ* have irregular flowers. Corolla nearly regular in a few genera of *Acanthaceæ, Gesneraceæ* and *Scrophulariaceæ.*

Nicandra has a 3–5-celled ovary.

Oroxylum (*Bignoniaceæ*) has 5 perfect stamens.

Ovary is 1-celled in *Orobanchaceæ, Lentibulariaceæ, Gesneraceæ* and *Martynia* (*Pedaliaceæ*).

Ovary is 4-celled in *Datura* and sometimes 4-celled by a secondary septum in some *Pedaliaceæ.*

Only 2 or few ovules occur in each cell in some *Acanthaceæ.*

Albumen sometimes scanty in *Gesneraceæ,* present in *Solanaceæ, Orobanchaceæ* and *Scrophulariaceæ.*

Families: 115. *Solanaceæ;* 116. *Scrophulariaceæ;* 117. *Orobanchaceæ;* 118. *Bignoniaceæ;* 119. *Gesneraceæ;* 120. *Lentibulariaceæ;* 121. *Pedaliaceæ;* 122. *Acanthaceæ.*

115. The Datura and Nightshade Family.

Herbaceous or shrubby, sometimes climbing or scrambling, juice not milky. *Hairs sometimes stellate. Leaves alt.,* sometimes in unilateral pairs with the two members of the pair unequal, simple, very rarely pinnate. *Flowers* medium or large, *regular* and 5-merous (exc. in ovary), *or with a tendency to zygomorphism* and sometimes 6–7-merous, *often in extra-axillary cymes* or terminating a cymose branch-system. Calyx persistent. Corolla with lobes rarely imbricate, usually plicate or the lobes valvate. *Stamens alternating with the lobes, sometimes unequal or some rudimentary.* Disc usually present. *Ovary obliquely 2-celled* (3–5-celled in *Nicandra,* many-celled in some *Lycopersicum*) or rarely 4-celled or 1-celled by absorption of septum. *Ovules very many on prominent or swollen axile placentæ* (few in some exotic genera). *Fruit baccate or capsular. Seeds compressed discoid or subreniform. Embryo often curved and peripheral in the albumen.*

Solanaceæ (p. 606).

116. The Mimulus and Veronica Family.

Herbs with opp. whorled or alt., *often gland-dotted,* simple, very rarely compound leaves. Calyx persistent, 4–5-lobed or -sepalous. Corolla rarely actinomorphic, lobes alternating with the sepals, imbricate, never plicate in bud. Stamens rarely 5 perfect, usually 4,

* The term "twisted" is not here used in the sense of contorted (where every lobe of the same whorl has one margin covered and one margin uncovered), but literally screw-like as often occurs in *Gentianales.* See Hole, *Manual of Botany,* p. 51 (1909).

often didynamous or sometimes only 2, anthers 2–1-celled. Disc annular or unilateral. *Ovary with 2 median carpels, 2-celled with large swollen placentæ on the septum* (axile). *Ovules many*, rarely few. Fruit capsular. Seeds usually numerous, albuminous. Embryo straight or slightly curved.................. *Scrophulariaceæ* (p. **617**).

117. The Broomrape Family.

Fleshy or scaly root-parasites or saprophytes with usually a *simple stem and no true leaves.* Fls. solitary spiked or racemed. *Calyx spathaceous or 4–5-sepalous.* Corolla hypogynous with curved tube and 2-lipped limb, upper lip arched, lower 3-fid, throat often with 2 villous folds. St. 4 didynamous, anthers 1–2-celled, more or less spurred. *Ovary* 2-carpellary, 1- *rarely* 2-*celled*, style long, tip curved, stigma capitate or 2-lobed. *Ovules usually many, on 2 pairs of free or confluent parietal placentæ* which sometimes meet in the axis. *Capsule* 1-*celled*, 2-valved or sub-indehiscent. *Seeds* few or many, *minute* with pitted or tubercled or rarely lax and reticulated testa. Albumen fleshy. Embryo ovoid simple or 2-fid.

Orobanchaceæ (p. **641**).

118. The Bignonia Family.

Woody plants, often (in exotic species) climbing by tendrils developed from the leaves. *Leaves* opposite, rarely whorled, sometimes spiral in the crowded leaves at the ends of the branches in some species, 1–3 *pinnate, rarely simple. Flowers* large or medium, 2-sexual. *Calyx spathaceous or* 2–5-*lobed.* Corolla usually tubular (at least below), then ventricose, lobes subequal and imbricate (rarely valvate) in bud. *St. didynamous*, often with a 5th present as a staminode, rarely (*Oroxylum*) 5 perfect, mostly inserted anteriorly in the corolla. Disc usually conspicuous. *Ovary* 2-*celled* (in the exotic *Crescentiæ* 1-celled), style long. *Ovules many in each cell. Fruit* elongate, *capsular and 2-valved with the valves separating from an often much swollen axis*, rarely (exotics only) indehiscent. *Seeds flat or* 3-*gonous, winged.* Cotyledons flat or folded, often 2-lobed......... *Bignoniaceæ* (p. **648**).

119. The Achimenes Family.

Herbs (in our area), *sometimes reduced to single leaf and inflorescence. Leaves usually radical*, opposite or alternate, simple, exstipulate. Flowers often large, sometimes much reduced, usually racemose, rarely cymose clustered or solitary. Calyx 5-merous, lobes valvate or open in bud. Corolla with long or short tube and usually 5 imbricate lobes. St. on the tube, usually didynamous, rarely 5 fertile, often only 2 fertile. *Ovary superior* (half-inferior in American genera), 1-*celled, placentæ often* 2-*fid and parietal*, sometimes meeting in axis and making ovary 2-celled. *Ovules very many*, anatropous. Fruit capsular (in our species). *Seeds very many, minute.* Embryo straight.

Gesneraceæ (p. **646**).

120. The Bladderwort Family.

Small often very delicate herbs, often rootless, sometimes twining, *inhabiting water or wet places*, and in *Utricularia* usually with minute

bladders on the creeping axis.* *Leaves* often evanescent, either *simple entire radical and rosulate* or *in water capillary and multifid.* *Fls.* often small, *on* 1–*many-fld. scapes. Calyx* 2–5-*lobed. Corolla* 2-*lipped and spurred*, upper lip entire or emarginate, lower usually larger entire or 3–6-lobed. *Stamens* 2, *inserted* on the base of the corolla, *anther-cells transversely confluent. Ovary* superior, globose, 1-*celled*; style short. *Ovules very many on a free basal placenta.* Fruit a 2–4-valved capsule or irregularly breaking up. Seeds many. *Lentibulariaceæ* (p. **643**).

121. The Sesamum Family.

Herbs with the *leaves* opposite or the upper alternate, *often* (especially the lower) *lobed or pinnatifid. Fls.* usually axillary or racemose. Calyx 4–5-lobed. Corolla tubular below, ventricose above, lobes imbricate. *Stamens didynamous or* 2 *only perfect*, a 5th often present as a staminode. *Ovary* 2-, *rarely* 1-*celled, or finally* 4-*celled by a secondary septum*, not deeply lobed. Ovules few, or *if many one-seriate only* in each cell, axile or in one-celled ovaries on divaricate parietal laminæ. *Fruit capsular or drupaceous.* Seeds wingless...*Pedaliaceæ* (p. **6€0**).

122. The Acanthus Family.

Herbs or shrubs, frequently undershrubs, only rarely aromatic. Leaves opp. (alt. in *Elytraria* and some *Staurogyne*), sometimes unequal in the pair, simple, *frequently with linear cystoliths.*† *Flowers* rarely solitary, *bracteate and bracteolate* (with few exceptions). Calyx 5- or 4-partite, rarely of several linear teeth (*Thunbergia*). Corolla lobes imbricate or twisted in bud. *St.* 4 *or* 2 *on the tube, anthers* 2–1-celled, *cells sometimes remote or superposed.* Disc usually evident. *Ovary usually elongate,* 2-*celled*, style filiform. *Ovules* 1–*many* in each cell *superposed in two rows* along the middle line of the septum (exc. *Thunbergia*, in which the two ovules in each cell are collateral). *Capsule loculicidal*, the septum splitting along the mesial line. *Seeds usually seated on hardened curved funicles produced into an acute tip* beyond them, mostly ovoid or compressed and orbicular.

Acanthaceæ (p. **€62**).

Order XXXIII. LAMIALES.

Woody or herbaceous, *usually with glands and aromatic or fœtid. Leaves opposite*, rarely whorled or alternate, very rarely compound, exstipulate. *Flowers irregular or subregular*, mostly cymose, cymes often racemed or panicled. Calyx gamosepalous, persistent. *Stamens* 4 *or* 2 with or without a rudimentary 5th, very rarely more than 5 (see exceptions). *Ovary of* 2 *carpels, often* 4-*celled* by the formation of a secondary septum and *frequently deeply* 4-*lobed*, rarely 2-celled and entire or 6–8-celled. *Style simple. Ovules usually* 2 *to each carpel*, collateral, *or* 1 *in each cell. Fruit of* 4 1-*seeded nutlets, or a drupe with* 4 *pyrenes* or 1–4-celled endocarp, rarely with an 8-celled endocarp,

* According to Goebel the distinction between axis and leaf fails in *Utricularia.*
† Visible externally as translucent dashes or small raised lines. Cystoliths only absent in some *Thunbergieæ, Nelsonieæ, Acantheæ* and *Aphelandreæ.*

sometimes with 2–4 valves on germination. Micropyle and radicle inferior. Albumen 0 or scanty.

Exceptions :—

Leaves digitately compound in *Vitex*, pinnatisect in some *Lavandula* and few other *Labiatæ*.

Flowers regular and 6–12-merous in *Symphorema*, and ovary sometimes 1-locular at apex, fruit sometimes 1-seeded by abortion of the other 3 ovules.

Families : 123. *Verbenaceæ ;* 124. *Labiatæ.*

123. The Teak Family and Lantana Family.

Woody, more rarely herbaceous, sometimes scandent by sarmentose shoots, often fœtid or quasi-aromatic from minute sunk glands, hairs often forked or stellate. Calyx persistent and often accrescent, usually 4–5-lobed or -toothed. Corolla usually 2-lipped and 5–4-lobed with the two posterior lobes connate. Stamens usually 4, rarely 2. Ovary of two connate carpels or more usually each carpel divided by a secondary septum into 2 cells. Style terminal. Ovules 2 to each carpel, usually attached to the infolded walls, more rarely basal or pendulous. *Fruit drupaceous with a* 4–1-*celled* stone *or* 4–1 *pyrenes* or partially connate drupels, sometimes quite dry... *Verbenaceæ* (p. **703**).

Exceptions :—

Ovary 8-celled in *Duranta*.
Ovules between the 4 wings of a central column in *Avicennia*.

124. The Mint and Sage Family.

Herbs or undershrubs, rarely shrubs, *usually with sweet or aromatic smell* due to ethereal oils secreted in glandular hairs often sunk in pits in the epidermis and sometimes giving rise to translucent dots. Stems often 4-sided. Flowers more or less zygomorphic, solitary or in contracted cymes in the leaf axils, or upper leaves reduced to bracts and flowers or cymes forming a spike or thyrse. Calyx tubular, persistent. Corolla with 4–5 subequal spreading lobes or 2-lipped, lobes imbricate in bud. Stamens inserted in the tube, 2 or 4 perfect, subequal and spreading or declinate or didynamous. Disc prominent. *Ovary free* 4-*lobed or -partite,* consisting of two divided carpels, *style arising from between the lobes.* Ovules 1 in each cell erect anatropous. *Fruit of* 4 *dry* (*in our area*) *indehiscent cocci or nutlets.*

Labiatæ (p. **725**).

Order XXXIV. RUBIALES.

Leaves opposite or whorled. Calyx superior small. Stamens isomerous, free. Ovary inferior, usually 2 (2–8)-*celled,* 2–*many-ovuled. Albumen copious.*

125. The Coffee and Gardenia Family.

Woody or herbaceous with opposite or whorled leaves and *interpetiolar* or *intrapetiolar stipules* (stipules apparently wanting in the whorled leaves of the *Galieæ*). *Flowers* small to very large, *regular,* 2-*sexual. Calyx* usually small with 4–5 *sepals,* rarely obsolete. *Corolla* 4–5-*merous* or rarely lobes up to 12. *St. usually isomerous*

(sometimes fewer where the corolla-lobes are more than 5) inserted in the tube or at the mouth of the corolla. *Disc epigynous.* Ovary mostly 2-celled, rarely 3–9-celled, vary rarely (*Gardenia*) 1-celled (with parietal placentæ), style simple or cleft. *Ovules* 1 or more in each cell, *usually on the septum.* Fruit various. *Cotyledons usually flat*..................................*Rubiaceæ* (p. 419).

Order XXXV. CAMPANALES.

Herbs often with milky juice. Leaves simple alternate, rarely opposite, exstipulate. Flowers regular or irregular. *Calyx superior*, rarely obsolete. *Stamens isomerous or rarely* (*Stylidaceæ*) *reduced to* 2, *free or connate with the style*, anthers free or connate. *Ovary completely inferior, usually* 2–5-*celled. Ovules many axile.* Fruit usually capsular. Seeds albuminous, many, small or minute.

Families: 126. *Campanulaceæ ;* 127. *Stylidaceæ.*

126. The Bell-flower Family.

Herbs or undershrubs. Flowers axillary or racemose or spicate, regular or (*Lobelieæ*) irregular, 2-sexual. Calyx 4–6-partite, usually persistent. Corolla with valvate lobes. *Stamens* 4–6, inserted with the corolla and *alternating with its lobes* on the margin of an epigynous disc (on the corolla-tube in *Sphenoclea*), anthers free or connate. Style 1 with stigmas as many as the cells. *Ovules on usually swollen placentæ. Fruit capsular or baccate.* Embryo erect.

Campanulaceæ (p. 499).

127. The Stylidium Family.

Fls. 1–2-sexual *irregular* in corymbs, cymes or panicles. *Calyx* 2-*lipped. Stamens* 2, *filaments connate with the style into a column.* Ovary 2-celled. *Ovules on the septum. Fruit a* 1–2-*celled,* 2-*valved capsule*, valves sometimes cohering top and bottom.

Stylidiaceæ (p. 498).

Order XXXVI. ASTERALES.

Herbs, rarely shrubs. Juice sometimes milky. Calyx superior, small or obsolete or changed to a pappus. *Stamens isomerous, mostly syngenesious. Ovary inferior* 1-*celled,* 1-*ovuled. Ovule erect. Seed exalbuminous.*

128. The Daisy and Thistle Family.

Leaves alt., more rarely opp., simple or pinnatifid, exstipulate, base of petiole often sheathing. *Flowers sessile in dense heads on a common receptacle surrounded by a calyx-like involucre of bracts.* Flowers homogamous or heterogamous, outer in a head often with ligulate limb, inner usually regular tubular or campanulate, sometimes all either regular or ligulate or somewhat lipped. *Calyx reduced to scales or hairs or* 0, if present usually persistent and enlarged in fruit. Stamens 5 (rarely 4) inserted in the corolla-tube, anthers very rarely free, finally exserted. Ovule basal anatropous with 1 integument. *Fruit dry indehiscent closely investing the exalbuminous seed*, often crowned by the pappus (modified calyx). Embryo straight.......*Compositæ* (p. 453).

240. Class II. MONOCOTYLEDONES.

The Monocotyledons are few compared with the Dicotyledons, and they are usually herbaceous. The arborescent forms are easily distinguished from dicotyledonous trees by the comparatively slender stems, unbranched or but slightly branched, and not much more slender at the top than at the base. This is due to the parts of the stem from which the leaves have fallen ceasing to grow further in thickness, though in some cases perhaps there is a gradual slight increase in volume of existing tissue elements. Anatomically the closed fibro-vascular bundles are seen to be scattered in a transverse section of the stem and there is no cambium ring, so that after the development of the primary bundle cylinder the arrangement of tissues within the epidermis or layer of periderm undergoes no further change. Exceptions to this general type of monocotyledonous tree-stem are only found in the arborescent *Liliaceæ*, such as Aloe, Yucca, *Dracæna* and *Cordyline*. In these a cambial layer finally appears, but none of these arborescent species are native in our area (though some are cultivated). The leaves of all of them are typically monocotyledonous. Exceptions to the generally unbranched character of the shoots are also found among the *Liliaceæ* (*e. g.* Asparagus, *Smilax*), some *Pandanus*, some grasses (especially the Bamboos), a few *Scitamineæ* (*Clinogyne*) and a few others.

The typical monocotyledonous leaf is simple, narrow, with parallel venation and a sheathing base; between the sheathing base and the blade may be a short petiole. Even the cotyledon has a sheathing base which wraps round the plumule. Sheathing bases sometimes occur in the Dicotyledons, especially in the *Ranales, Rosales* and *Umbellales*. Exceptions to the typical monocotyledonous leaf occur chiefly in the *Aroids, Dioscoreaceæ, Taccaceæ* and Palms. But none of these much resemble Dicotyledonous leaves. In the palms the leaves are often pinnate or flabellate, but the leaflets are monocotyledonous or flabellate and texture hard. The aroids and *Taccaceæ* have often pedate leaves; where broad and simple the venation is usually palmate with secondary nerves straight and transverse, rarely reticulate; the dicotyledonous leaves nearest in appearance to the *Dioscoreaceæ* are perhaps some of the *Convolvulaceæ*. The *Araceæ, Taccaceæ* and *Dioscoreaceæ* have, with few exceptions, tuberous rootstocks like so many other Monocotyledons. The parts of the flower in those Monocotyledons with a perianth are usually in *threes*. The inflorescence is very often enclosed, at least at the base, by a sheathing leaf-base or *spathe*.

241. SYNOPSIS OF ORDERS AND FAMILIES OF THE MONOCOTYLEDONS.

Order I. FLUVIALES (Helobiæ).

Aquatic or marsh plants. Flowers regular, often heterochlamydeous and *with* 3-*merous whorls throughout, or stamens and carpels numerous,*

or *flowers reduced. Ovary apocarpous and superior* to (*Hydrocharitaceæ*) syncarpous and inferior. *Fruit of follicles, achenes, capsular* or *membranous or nut-like.* Seed without albumen. Embryo with large swollen hypocotyl.

Families: 129. *Alismaceæ*; 130. *Naiadaceæ*; 131. *Hydrocharitaceæ.*

129. The Water Plantain Family.

Leaves *radical.* Fls. *heterochlamydeous.* Calyx and corolla-3-*merous.* Stamens *hypogynous or perigynous.* Carpels 3–6 or more, 1-celled, *free.* Fruit of achenes or follicles.......*Alismaceæ* (p. 843).

130. The Naiad Family.

Leaves opp. or alternate, submerged or floating. Flowers *inconspicuous*, 1–2-sexual, *homoiochlamydeous.* Perianth of 3–4 *tepals* or *tubular and hyaline* or 0, rarely of 2–1 tepals. Stamens 6–1, *hypogynous in the 2-sexual fls.*, sometimes connate in male. Carpels 6–1. Ovule 1 *in each carpel*, rarely (*Aponogeton*) 2 or more. Fruit of achenes, drupels or (*Aponogeton*) follicles........*Naiadaceæ* (p. 846).

131. The Vallisneria Family.

Leaves submerged or floating. Flowers inconspicuous to showy, 1–2-sexual, *enclosed in a spathe*, female solitary, homoio- or heterochlamydeous. Sepals 3. Petals sometimes 0. Stamens 3–12, rarely 2–1, sometimes one or two whorls of staminodes. *Ovary inferior*, placentæ *parietal or almost axile*, stigmas 3–12. Ovules anatropous or orthotropous. Fruit membranous or fleshy.
Hydrocharitaceæ (p. 852).

Order II. SPADICIFLOREÆ.

The common characters of this order are, with the exception of the most reduced forms, *numerous, frequently 1-sexual, flowers massed on a common simple or branched often fleshy axis*, the *spadix*, which in the majority of cases is subtended by and at first *sheathed by one or more large modified foliage leaves*, "*spathes*," which may be persistent deciduous or caducous. The flowers of many show the normal monocotyledonous arrangement, but with a *dry or inconspicuous perianth, in two 3-merous whorls* and 3 free or connate carpels. From these are all gradations *to flowers consisting of single stamens or ovaries.* Trees, often with very compound leaves, or shrubs (sometimes woody climbers, *e. g.* rattans) or herbs with simple or compound leaves or plants reduced to minute floating thalloid bodies (Duckweeds).

Sub-order *Arales.* Fam.: 132. *Araceæ*; 133. *Lemnaceæ.*
Sub-order *Pandanales.* Fam.: 134. *Pandanaceæ*; 135. *Typhaceæ.*
Sub-order *Palmales.* Fam.: 136. *Palmaceæ*; 137. *Cyclanthaceæ.*
Each sub-order begins with the more normal and ends with the more reduced families.

Sub-order I. ARALES.

Herbaceous, rarely aquatic (minute aquatics in *Lemnaceæ*), usually tuberous or rhizomatous. L. usually broad and fleshy, simple or

divided, not distichously appressed face to face. Spadix usually fleshy and bearing a coriaceous or fleshy spathe enclosing the spadix, at least when young.

132. The Aroid Family.

Herbs, frequently tuberous or rhizomatous with annual shoots, sometimes perennial climbers, *rarely aquatic*, usually *quite glabrous and somewhat fleshy*. Leaves well-developed *simple or palmately or pedately divided*, rarely pinnatifid. Flowers *crowded on a simple fleshy spadix with* green or coloured persistent or deciduous sometimes petaloid *spathe, usually monœcious* with the female fls. below the male. *Spadix often produced beyond the fls.* Perianth of 4–8 segments or cupular or *usually suppressed*. Anthers in 2-sexual fls. 4–8, in *1-sexual fls. often reduced to* 1–8, *often united into synandria* with the connective overtopping the cells. *Ovary* superior *usually* entire, 1–many celled. Ovules 1–*several in each cell*, anatropous or orthotropous. Fruit mostly baccate. *Seeds albuminous with axile embryo.*

Araceæ (p. **856**).

Exceptions :—

In the semi-aquatic or aquatic genera *Cryptocoryne* and *Pistia*, the spadix is much reduced and the ovary is solitary or ovaries in a single basal whorl.

Leaves linear in *Cryptocoryne*. Flowers diœcious in *Arisæma*. Seed without albumen in *Pothos*.

133. The Duckweed Family.

Minute floating aquatics with the shoot consisting of a green thalloid flat or plano-convex expansion, increasing copiously by gemmation. *Flowers* minute *consisting of* 1–2 *naked stamens* or *a naked 1-celled ovary*, both sometimes enclosed in a common minute membranous spathe and reaching the exterior by a lateral cleft in the frond. *Ovary 1-celled* with 1–7 ovules. Seed with or without albumen.

Lemnaceæ (p. **873**).

Sub-order II. PANDANALES.

Woody plants or marsh herbs. Leaves undivided, long and narrow, placed *more or less with their flat sides opposed.* Spathes usually deciduous, sometimes wanting. *Perianth* 0 *or of hairs. Seed albuminous.*

134. The Screw Pine Family.

Shrubs sometimes nearly stemless, *or trees*, often with stilt roots. *Leaves spirally arranged spinulosely toothed. Flowers* diœcious, crowded on simple or branched spadices. Perianth 0. *Male with numerous stamens*, limits of an individual flower often not defined. Ovary of one to several carpels and cells. Stigmas distinct. Ovules solitary and suberect or many parietal. *Fruit of 1–several-celled woody or fleshy drupes, the whole forming a large syncarp.* Seeds minute. . . . . *Pandanaceæ* (p. **876**).

135. The Reed-mace Family.

Marsh herbs, often tall with *erect distichous linear leaves. Flowers monœcious*, arranged like the aroids with the male portion of the spadix above the female or sometimes two or more cylindric female spikes below the male. *Perianth* 0 *or of hairs. Male fl. with* 1–5 *stamens.* Fem. with a *minute stipitate carpel with* 1-*pendulous ovule.* Fruit very minute with membranous pericarp.....*Typhaceæ* (p. 875).

Sub-order III. PALMALES.

Trees or shrubs with distichous or spiral *large flabellate or digitate or pinnately compound plicate leaves.* Flowers monœcious or diœcious. Ovary free or immersed in the spadix, *apocarpous or syncarpous,* 1–3-*celled.*

The *Cyclanthaceæ* are united here with the *Palmaceæ* for convenience. They only bear a superficial resemblance to one another, and in some respects the *Cyclanthaceæ* appear closer to the Aroids and in others to the *Pandanaceæ.*

136. The Palm Family.

Woody plants with a *terminal unbranched crown of large rigid leaves* or sometimes widely scandent with alternate leaves, or sometimes leaves distichous, *plaited, palmate or pinnately divided. Flowers* mostly small, never brightly coloured, *usually brown or scarious, spadices often very compound. Perianth in* 2 3-*merous whorls. Stamens* 3 *or* 6. Ovary superior of 3 1-celled carpels or syncarpous and 1–3-celled. Ovules 1–2 in each carpel, anatropous. Embryo small in a cavity near the surface of the albumen..........*Palmaceæ* (p. 878).

137. The Cyclanth Family (*Carludovica* only described).*

A small palm-like shrub. Flowers of both sexes densely crowded on the same simple spadix. *Male perianth toothed. Female sunk in the rhachis.* Ovary 1-celled with 4 sessile stigmas. Ovules very many on 4 parietal placentæ.................*Cyclanthaceæ* (p. 878).

Order III. GLUMIFLORÆ.

(Grasses and Sedges.)

Herbs with grass-like leaves or, if woody, then with long slender mostly hollow " culms " which *complete their height growth in one year. Flowers much reduced,* each standing in the axil of one of a number of imbricating bracts (glumes) on the slender axis of a "*spikelet*," 1–2 sexual. *Perianth reduced* to scales or bristles or 0. *Stamens* in the normal 2 whorls of three (some Bamboos) or *usually* 3 *or* 2 *only. Ovary* of 3–1 united carpels, 1-*celled*, 1-*ovuled.* Fruit usually a nut, the seed fused with the pericarp, rarely free, albumen copious.

A highly evolved group probably derived from low down on the Monocotyledonous stock, and flowers much reduced.

Families: 138. *Cyperaceæ ;* 139. *Gramineæ.*

* *N.B.*—Herbaceous members occur in this family, which is not indigenous.

138. The Sedge Family.

Grass-like herbs. *Stems usually 3-angled* or the *leaves tristichous* with closed, rarely open sheaths. *Ligule obscure or* 0. *Flowers* 1–2-sexual in the axils of the glumes *without a palea* (bracteole). *Perianth of* 6 *scales* or *bristles* or a number of *hairs or* 0. Stamens 3–1, *anthers basifixed.* Ovary 2–3-carpellary, *stigmas not feathery.* Embryo basal median.......................................*Cyperaceæ* (p. **888**).

Exceptions :—

In the *Carices* the ovary is enclosed in a utricle through the top of which the stigmas project. From comparison with an allied genus (*Elyna*) it appears that the female flower is the remnant of a secondary spkt. in the axil of the bract; this secondary spikelet bears a convolute bract (utricle) in the axil of which is the naked female flower. The rest of the secondary shoot is abortive in *Carex.*

139. The Grass Family.

Herbs or woody (Bamboos). *Stems* if angled *2-edged*, and *leaves distichous* with usually open sheaths and *generally distinct ligule.* Fls. 1–2-sexual, in the axils of the glumes and also *subtended by a palea opposed to the glume*, rarely palea 0. Perianth of 2, rarely 3, minute scales or "*lodicules*" or sometimes 0. Stamens 6–1, *anthers versatile.* Ovary probably of 1 carpel but with usually 2 *feathery stigmas.* Embryo basal lateral...................*Gramineæ* (p. **937**).

Order IV. ENANTIOBLASTEÆ.

(Probably derived low down from the *Liliiflorous* stock.)

Herbs agreeing in the *ovule being straight* instead of anatropous as in most Monocotyledons, the *embryo lying at the opposite end* (or side, where the funicle is lateral) *to the hilum.* Frequently swamp plants with radical or alternate *leaves with sheathing base and rarely distinct petiole. Flowers hypogynous*, of typical monocotyledonous type of 5 3-merous whorls in a well-developed 2-sexual flower, or calyx and corolla sub-similar and very small and especially where flowers are in capitate inflorescences, calyx or corolla reduced to 2 members or to hairs, or corolla 0. Inflorescence cymose in spathes, or often capitate without spathe, rarely panicled. Seeds sometimes laterally attached. *Albumen copious flowery. Embryo minute.*

Families: 140. *Commelinaceæ;* 141. *Xyridaceæ;* 142. *Eriocaulaceæ.*

Exceptions :—

The *Flagellariaceæ* are included here by most German authors and in the body of the Flora. But they show very many exceptions. Especially the ovules are anatropous with the radicle close to the hilum and the flowers remind one of the *Juncaceæ*, with which they are here placed. They, however, resemble the *Enantioblasteæ* in the laterally attached seeds and floury albumen.

140. The Commelina Family.

Herbs with usually more or less *lanceolate or ovate parallel-nerved leaves* with a sheath. *Flowers often cymose* with the cymes enclosed in conduplicate spathes, but sometimes spathes absent and flowers panicled, *heterochlamydeous and often irregular.* Calyx 3-merous.

Corolla larger, often blue, 3-merous, but 2 petals often larger or longer clawed than the third. Stamens normally 6 in two 3-merous whorls inserted at base of corolla, but often 2 or more reduced to staminodes, *filaments often bearded.* Ovary superior 3-celled or one cell abortive. Ovules 1 or more in each cell, axile, laterally attached.
Commelinaceæ (p. **1074**).

141. The Xyris Family.

Tufted herbs with *radical linear* or *subulate and rush-like leaves* and *naked scapes* sheathed at the base with a terminal *2-sexual head* or spike of small sessile *yellow flowers in the axils of imbricating bracts. Fls. heterochlamydeous* somewhat irregular. Calyx with one sepal larger and caducous. Petals 3, clawed, marcescent. Stamens 3 fertile and 3 reduced or 0. Ovary 1- or incompletely 3-celled. *Ovules many*............................*Xyridaceæ* (p. **1072**).

142. The Pipe-wort Family.

Marsh or aquatic herbs with *narrow, grass-like or rush-like leaves, radical* (except when submerged) and *very minute flowers* in *involucrate heads on naked scapes,* usually monœcious. Perianth in two whorls *sub-homoiochlamydeous, scarious.* Sepals 2–3, free or connate, petals 2–3 or of hairs or 0, often on top of a stipes or slender corolla-tube. Stamens 6 or fewer. *Ovary* 3- *rarely 2-celled,* stigmas 3–2. *Ovules solitary in the cells, pendulous.* Capsule 3-lobed. Embryo outside the albumen............................*Eriocaulaceæ* (p. **1066**).

Order V. CALYCINÆ.

Herbs or suffruticose (*Flagellaria*) and sometimes scandent with narrow tubular or septate or flat simple leaves. *Flowers regular homoiochlamydeous* with the *perianth mostly dry* or scarious or occasionally green, rarely the inner whorl somewhat corolline in texture, in cymose clusters or panicles, 1–2-sexual. *Tepals inferior in* 2 *3-merous whorls. Stamens* 6 hypogynous with basifixed anthers. *Ovary* superior 3- *rarely 1-celled,* with styles or stigmas 3. *Ovules* 1–many axile in each cell, or parietal on 3 placentæ in the 1-celled ovary, *anatropous.* Fruit drupaceous with 1–3 pyrenes or loculicidally 3-valved. Seeds erect (*Juncaceæ*) or laterally attached (*Flagellariaceæ*). Albumen copious, embryo next the hilum.

Families: 143. *Flagellariaceæ ;* 144. *Juncaceæ.*

143. The Flagellaria Family.

Stem leafy erect or scandent and sub-woody, *climbing by the cirrhose leaf-tips.* Leaves lanceolar, sheathing. *Flowers in terminal panicles,* homoiochlamydeous, subscarious white or brown, regular, or tepals somewhat unequal. *Ovary 3-celled.* Ovules 1 in each cell, axile. Fruit fleshy or drupaceous. Seeds laterally attached. Embryo lenticular or sub-spherical. Albumen copious floury.
Flagellariaceæ (p. **1073**).

144. The Rush Family.

Erect herbs with tufted stems and leaves on a perennial stock, rarely annual. *Leaves mostly terete, slightly flattened or concave above.* Flowers green or brown and sub-scarious or coriaceous, cymose, regular. *Ovary* 1–3-*celled.* Ovules many axile in the 3-celled ovary, rarely 3 only and basal in the 1-celled ovary, anatropous. Fruit capsular, 3-valved. Seeds not laterally attached, mostly elliptic with the testa often produced both ends............*Juncaceæ* (p. **1083**).

Order VI. LILIIFLORÆ.

(←— Probably derived from low down on the monocotyledonous stock, but leading to the most highly evolved orders.)

Mostly herbs, stock very often bulbous, occasionally shrubs with a crown of sword-shaped leaves. *Flowers regular* or somewhat zygomorphic, but nearly always *with* 5 *alternating* 3-*merous floral whorls* (the inner whorl of stamens is suppressed in the *Iridaceæ* and some *Burmanniaceæ*). *Perianth with both whorls usually petaloid*, tepals free or connate. *Ovary* inferior or superior or half-inferior 3-*celled with* 2 *rows of anatropous ovules* axile in each cell. Albumen always present and usually fleshy or cartilaginous.

Exceptions :—

Flowers very small and usually diœcious in *Dioscoreaceæ*.

Flowers heterochlamydeous in *Bromeliaceæ*, irregular in *Pontederiaceæ*, 2- or 4-merous in *Roxburghiaceæ* and few *Liliaceæ*.

Ovules 1–2 erect or ascending in each cell or pendulous in some *Hæmadoraceæ, Roxburghiaceæ, Dioscoreaceæ*, and a few genera of other families, *q.v.*

Albumen mealy in *Pontederiaceæ* and few *Bromeliaceæ*, on which account they are sometimes included in *Enantioblasteæ*.

Placentæ 3 parietal in some *Pontederiaceæ* and *Taccaceæ*. Seeds minute with rudimentary embryo and albumen of few cells only in *Burmanniaceæ*.

Families :—

A. (*Coronarieæ*), ovary superior, free rarely shortly adnate at base :— 145. *Liliaceæ ;* 146. *Roxburghiaceæ ;* 147. *Pontederiaceæ.*

B. (*Epigynæ*), ovary inferior or half inferior :— 148. *Hæmadoraceæ*; 149. *Amaryllidaceæ;* 150. *Taccaceæ;* 151. *Bromeliaceæ* (ovary sometimes superior); 152. *Dioscoreaceæ;* 153. *Burmanniaceæ;* 154. *Iridaceæ.*

145. The Lily Family.

Herbs, rarely shrubs or trees with a secondary growth in thickness. Leaves various, rarely reduced to scales, usually parallel-nerved. *Flowers* mostly 2-*sexual, regular*, rarely umbelled. *Perianth inferior, petaloid*, tepals free or connate at base into a tube, in 2 3-merous whorls. *Stamens* 6 *hypogynous or on perianth. Ovary* free 3-*celled* with *axile placentation.* Ovules in each cell 2–many, anatropous. Fruit baccate or capsular. Seeds with copious albumen. Embryo straight or curved with radicle usually near the hilum.
Liliaceæ (p. **1084**).

Exceptions :—

Ovules 1–2 in each cell, pendulous, straight in *Smilax*.
Ovules 1 erect in each cell or ascending from the lower angle in *Dracæna* and *Sanseviera*.
Flowers slightly irregular in *Gloriosa*.

146. The Roxburghia Family.

Herbs, twining in our species, *with alt. opp. or whorled leaves. Flowers* axillary or racemose, regular, 2–4-*merous. Perianth half inferior*, tepals in 2 2-merous whorls. Stamens 4 sub-hypogynous. Ovary free or half inferior 1-celled. Ovules 2 or more erect, anatropous. *Capsule compressed, 2-seeded.* ....*Roxburghiaceæ* (p. 1100).

147. The Water Hyacinth Family.

Aquatic herbs with erect or floating leaves. *Flowers* spiked or racemed, *irregular. Perianth unequally* 6-*partite. Stamens* 1–6, one usually longer than the others. Ovary free 3-celled, or 1-celled with 3 *parietal placentæ.* Ovules 1 or more on each placenta. Fruit a loculicidal capsule. Seeds with horny or floury albumen.
Pontederiaceæ (p. 1101).

148. A small family separable from the *Liliaceæ* by the *frequently zygomorphic flowers*, the *outer whorl of stamens sometimes absent*, the *three* present *standing opposite the inner tepals*, sometimes *stamens connate in a ring closing the mouth of the perianth, filaments very short. Ovary* often *inferior* or half-inferior, 3-*celled and containing in each cell few semi-anatropous ovules* or (in *Peliosanthes*) with 1–2 ascending ovules. Stigma capitate. *Fruit* capsular or (*Peliosanthes*) seeds bursting through the thin pericarp while ripening. Embryo small in the fleshy albumen.......................*Hæmodoraceæ* (p. 1099).

The genera with 1–2 sub-erect ovules and 6 stamens (including *Peliosanthes*) are sometimes included in the *Liliaceæ*. Thus limited there are no Indian species, *Sanseviera* sometimes included in this family being transferred to *Liliaceæ*.

149. The Amaryllis and Agave Family.

Herbs often bulbous, or shrubs with a stout caudex and a *crown of large ensiform leaves. Leaves nearly always narrow*, rarely ovate, parallel-nerved. Flowers as in *Liliaceæ* but *more often umbelled* with the umbel (sometimes reduced to a single flower) *supported by one or more spathes*, more often somewhat zygomorphic with declinate stamens, but especially differing in the *inferior ovary. Frequently a corona present* between or at the back of the stamens. Embryo small straight excentric, enclosed in albumen......*Amaryllidaceæ* (p. 1102).

Exceptions :—

Leaves plicate in *Curculigo* and flowers sometimes 1-sexual.

150. A small family with the *leaves*, from a tuber, *deeply partite, lobed or pinnatifid. Fls. umbellate* and supported by a common spathaceous involucre. *Perianth with a short broad tube*, lobes 6. *Stamens* 6 *cucullate with* the anthers inside the cowl. *Ovary* 1-*celled* with 3 *parietal placentæ.* Ovules many, anatropous or almost amphitropous..............................*Taccaceæ* (p. 1114).

151. The Pine-apple Family.

An American family mostly with *clustered radical* or sub-radical *leaves spirally arranged* and sheathing with an amplexicaul base. *Inflorescence commonly from the centre of the leaf-rosette,* spiciform capitate or panicled, and *frequently with brilliantly coloured bracts,* sometimes with a crown of leaves or bracts terminating the axis. Sepals 3 free or connate. Petals 3 free or united into a tube below. Stamens 6. *Ovary inferior, half-inferior* or superior, 3-celled. *Ovules usually very many,* anatropous. Fruit baccate, sometimes (as in the pineapple) *fruits combined into a syncarp.*

Bromeliaceæ (p. **1114**).

152. The Yam Family.

Twiners from a *tuberous rootstock* or from a hard rhizome which frequently bears succulent tubers at the ends of long fleshy fibres. Leaves opposite or alternate, simple or digitately 3–5-foliolate, *palminerved* and with scalariform or reticulate venation between the principal nerves. *Fls. small, regular, diœcious.* Tepals in two 3-merous whorls. *Male with* 3 *or* 6 *stamens* or 3 st. and 3 staminodes. *Ovary inferior,* 3-celled and 3-*quetrous* with 2 ovules in each cell. *Frt.* capsular, 3-*winged* (in our species). Seeds flat.

Dioscoreaceæ (p. **1115**).

153. *Herbs* with *linear radical leaves* or *leaves reduced to scales. Flowers regular,* 2-sexual, spicate or racemed or solitary or on the branches of cymes. *Perianth adnate to the ovary* (*hypanthium coloured*) and produced above it into a persistent 6- rarely 3-lobed *gamophyllous often angled tube* with *valvate lobes. Anthers* 6 *or* 3, sessile on the perianth. Ovary inferior 3- or 1-celled. *Ovules many small anatropous.* Fruit capsular. Seeds minute. *Albumen few-celled only. Embryo very minute* . . . . *Burmanniaceæ* (p. **1124**).

154. The Iris Family.

Herbs with *usually tuberous rootstock* and narrow *often equitant leaves.* Flowers 2-sexual, regular or somewhat zygomorphic. Perianth with two 3-merous whorls more or less connate at the base, tepals imbricating. *Stamens* 3, *adnate to the outer whorl or epigynous,* free or connate. *Ovary* 3-*celled inferior. Style branches* rarely simple, *often petaloid.* Ovules many 2-seriate axile. Fruit capsular. Seeds many. . . . . *Iridaceæ* (p. **1125**).

Order VII. SCITAMINEÆ.

Perennial, usually large, *rhizomatous herbs,* sometimes arboreous in form, very rarely stem woody. *Leaves* well developed with *sheath petiole and blade* and *closely nerved. Flowers mostly very irregular,* 2-sexual, usually spicate, heterochlamydeous. *Calyx* superior *spathaceous* or tubular *or sepals imbricate.* Corolla tubular below with 3 free or connate petals. *Andrœcium mostly very irregular* with only *one perfect anther* or one cell of an anther, the remainder of staminodes, *two or more of which are usually petaloid,* rarely (*Musaceæ*)

with 5 perfect stamens and one staminode. *Ovary inferior* 3-celled with axile placentation, rarely with 3 parietal placentæ. Style slender; 2 very short stylodes usually present. Ovules many anatropous. Albumen floury. Embryo small.

Families: 155. *Musaceæ;* 156. *Zingiberaceæ;* 157. *Cannaceæ;* 158. *Marantaceæ.*

Exceptions :—

Flowers in *Musa* sometimes 1-sexual.
Ovules 1 only in each cell in *Marantaceæ.*

155. The Banana Family.

Large or gigantic herbs rarely woody (*Ravenala*) but often arboreous in form, the large stem usually composed of convolute leaf-sheaths, through the centre of which the inflorescence is thrust up until it emerges from the top as a stout spike covered with coloured bracts or spathes. Lowest spathes sometimes empty, next with 1- or 2-sexual flowers and terminal often remaining unopened. Flowers often zygomorphic with *perianth* in two whorls *colourless or coloured*, segments free or connate, sometimes unequal. *Fertile stamens* 5, very rarely 6, the posterior usually a staminode. *Ovary 3-celled.* Ovules 1–many in each cell.......................... *Musaceæ* (p. 1126).

156. The Ginger Family.

Perennial herbs, often very large, *usually from a rhizome.* Stem distinct or composed of convolute leaf-sheaths. Scape central or distinct from the leafy stem. Inflorescence spicate, capitate or panicled, rarely fls. solitary, *often showy,* irregular. *Stamen only one perfect* and anther 2-*celled.* The stamen is the dorsal one of the typical inner whorl of which the two ventral are staminodes combined into a petaloid lip. *Outer whorl* of andrœcium *absent* or *two* members present as teeth, lobes or petaloid *staminodes.* Ovary 3- rarely 1-celled. Ovules many. Seeds often arilled.
Zingiberaceæ (p. 1128).

157. The Indian-shot Family.

As in Zingiberaceæ but *andrœcium* consisting of a *single fertile anther-cell on the margin of a petaloid stamen.* Opposed to the fertile stamen is a recurved petaloid staminode and in addition are 2–3 erect petaloid staminodes, all more or less adnate to the corolla tube. *Style* adnate at the base to the staminal tube, *broad and flattened* upwards *with small* terminal and oblique stigma. *Ovules several in each cell* in 2 series. Capsule 3-celled, papillose tubercled or echinate. Seeds globose.......................... *Cannaceæ* (p. 1147).

158. The Arrowroot Family.

Closely resembling the last two families. *Petiole above the sheath geniculate or swollen. Fls. paired in the bracts. One stamen only fertile* with *a single perfect anther-cell,* the other half of the stamen being petaloid. The other two staminodes of the inner staminal whorl are the "*cucullate staminode*" which is furnished on one side with a cucullate appendage, and "*the labellum*" which is broader

and *often hardened.* Of the outer whorl 1 or 2 staminodes are petaloid, or sometimes all 3 fail. Style stout curved, at first included in the cucullate staminode. *Ovule* 1 *in each cell*....... *Marantaceæ* (p. **1148**).

Order VIII. GYNANDRÆ.

Terrestrial or epiphytic perennial herbs, often with pseudobulbs or fleshy stems, the joints of which form a sympodium. Leaves mostly fleshy or coriaceous, sometimes plicate. *Flowers irregular, usually very zygomorphic.* Perianth in two whorls, usually of similar texture. *Calyx superior,* 3-merous. *Petals* 3, one, *the "lip," dissimilar from the other two. Stamens and style combined into a column. Anther usually one only,* rarely (*Cypripedieæ*) two, sessile or sub-sessile on the column, *opposed to the lip. Pollen cohering* in each anther-cell *into* 1, 2 or 4 *masses* (*pollinia*) which are waxy or granular. Ovary inferior, 1- rarely 3-celled. Stigma one or two viscid areas on the top or front or on lateral processes of the column. Seeds most minute and numerous. Embryo not differentiated.

159. The Orchid Family........................*Orchidaceæ* (p. **1150**).

ABBREVIATIONS AND SIGNS.

The abbreviated names of botanists are not included. A fairly complete list of these will be found in Watt's *Dictionary of Economic Products*, I, xxvii, available in all Indian official libraries.

Synonymy has not usually been given except where the name differs from that used in—

(*a*) *The Flora of British India* (*F.B.I.*).
(*b*) Brandis's *Forest Flora* (*Br. For. Fl.*).
(*c*) Brandis's *Indian Trees* (*Ind. Trees*).
(*d*) Prain's *Bengal Plants* (*Beng. Pl.*).
(*e*) *The Forest Flora of Chota Nagpur* (*Fl. Ch. Nag.* or *F.C.N.*).

The name given by Roxburgh in his *Flora Indica* (*Fl. Ind.* or *Roxb.*) has sometimes been added.

Reference has often been made to the Rev. A. Campbell's *Descriptive Catalogue of the Economic Products of Chutia Nagpur* (*Desc. Cat.*) and to his herbarium (*Camp. Herb.*), and sometimes to Wood's *Plants of Chutia Nagpur* (Wood) and Thomas Anderson's paper on "The Flora of Behar and the Mountain Parasnath" (Anderson), published in the *Journ. Asiatic Society of Bengal*, 1863. *H.B.C.* or *Hort. Bot. Cal.* is the Herbarium at Sibpur, Calcutta. *C. & N.* refers to the systematic list of the plants of Barkuda Island in the Chilka Lake by Dr. H. G. Carter and Mr. V. Narayanswami of the Botanical Survey of India published in the *Memoirs of the Asiatic Society of Bengal*, 1922. Other botanical works and herbaria quoted in the text have been referred to in full or the abbreviations are sufficiently obvious.

Of works not exactly botanical reference has often been made to *Indian Plants and Drugs* (*I. P. & D.*) by Nadkarni, and to *The Materia Medica of the Hindus* (*Mat. Med.*) by U. C. Dutt, or the names of these authors have been cited.

The following indicate the languages to which a vernacular name is supposed to belong :

Beng. = Bengali, H. = Hindi, K. = Kol, *i. e.* including both Mundari (*M.* or *Mund.*) and Ho (where these are not given separately), Kharw. = Kharwari, S. = Santali, Sans. = Sanskrit, Or. = Oriah, Ur. = Uran, Th. = Tharu.

DESCRIPTIVE ABBREVIATIONS AND ABBREVIATED PLACE NAMES.

alb. . . . . . albumen, endosperm.
alt. . . . . . alternate.
B. & O. . . . . . Bihar and Orissa.
C.P. . . . . . Central Provinces
c.s. . . . . . cold season.
cold. . . . . . coloured.

cor.	corolla.
C.T.	Central Tract.
cult.	cultivated.
ell.	elliptic.
exc.	excepting or excluding.
f.	fide.
fem.	female.
fl. or fls.	flowers.
fr. or frt.	fruits.
ft.	feet.
gl. or gls.	glumes.
h.s.	hot season.
hyp.	hypanthium.
inc.	including.
inf. or inflor.	inflorescence.
L. or l.	leaves.
lanc.	lanceolate.
lflts.	leaflets.
m.s.	moderate or medium sized.
m. fls.	male flowers.
N.T.	Northern Tract.
opp.	opposite.
oblanc.	oblanceolate.
Par.	Parasnath.
ped.	peduncle or pedicel.
ped. spkt.	pedicelled spikelet.
per.	perianth.
pet.	petals.
peti.	petiole.
r.s.	rainy season.
sec. n.	secondary nerves: when followed by a number this number refers to the number of secondary nerves *each side* of the midrib; the words 'each side' are usually omitted.
sep.	sepals.
S.P.	Santal Parganas.
spkt.	spikelet.
S.T.	Southern Tract.
st.	stamens.
syn.	synonym.
tep.	tepals.
var.	variety.
vern.	vernacular.

SIGNS.

! added after a locality, but without the name of collector or of herbarium, signifies that the author has himself seen the plant in the locality named (or in the case of Kalahandi, obtained a specimen through a collector sent to that State by himself).

! The same sign following *the name of a person* in italics signifies that the author has seen a specimen of the species concerned collected by, or in the herbarium of, the person named.

Italics. The name of a locality followed by *the name of a person* in italics but without the sign ! signifies that the locality is given on the authority of the person named, but that the author has either not seen it or is uncertain of the identification.

′ and ″. Feet and inches respectively.

∝. numerous or indefinite.

+. The plus sign when used for parts of a flower, *e. g.* petals 3 + 3, indicates separate whorls. In the example, two whorls of 3 petals in each whorl.

Type. Page and family *numbers* in the Introduction in deep type refer to the numbers in the body of the work.

GLOSSARY OF BOTANICAL TERMS USED IN THE FLORA.

ABRUPTLY ACUMINATE, passing suddenly into a tapering point at the apex.

ACCRESCENT, continuing to grow.

ACHENE, a dry 1-seeded carpel of an apocarpous fruit, *e. g.* the pips of a strawberry.

ACHLAMYDEOUS, without covering. A term applied to a flower devoid of any perianth.

ACICULAR, needle-like, long, slender and rigid.

ACROPETAL, with the youngest organs nearest to the apex.

ACROSCOPIC SIDE, that side of a lateral organ towards the apex of the parent axis. *Cp.* Basiscopic.

ACULEATE, prickly, usually applied to somewhat curved prickles like those of a rose, and which are not morphologically branches.

ACUMINATE, ending in a tapering apex.

ACYCLIC, not arranged in whorls. A term applied to the parts of a flower when these are arranged spirally on the axis.

-ADELPHOUS, combined in groups; *e. g.* monadelphous, combined in one group.

ADHERENT, when the members of a flower become united in the course of growth to the members in a different whorl and of a different character, *e. g.* when the stamens become united to the corolla. *Cp.* Coherent.

ADHESION, the state of being adherent.

ADNATE, *see* Adherent.

ADNATE ANTHERS, *see* Anthers.

ADVENTITIOUS, not arising in the regular order from the growing apices, but subsequently and irregularly.

ÆSTIVATION, the arrangement of the parts of the floral envelopes in bud.

ALBUMEN, a general name for the nutritive tissue stored up in a seed outside the embryo, whether endosperm or perisperm.

ALBUMINOUS, containing albumen.

ALTERNATE, the relative position of lateral members on an axis when neither opposite nor whorled.

AMPHITROPOUS, said of an ovule which is curved round so that one end approximates to the other.

ANATROPOUS. An anatropous ovule is an ovule inverted on the funicle or stalk in such a way that though the nucellus remains straight the micropyle is directed towards the point of origin of the funicle which is adherent to the side of the ovule. *Vide* also Ovule.

ANDRŒCIUM, a collective word for all the stamens (and staminodes) in a flower.

ANNULUS, a row or group of specially thickened cells on the sporangia of many ferns, usually arranged in a ring interrupted at one point and by its elastic straightening rupturing the sporangium.

ANTERIOR, the side remote from the parent axis. The antithesis to Posterior. Unless twisting of the pedicel has taken place the anterior sepal or sepals of a flower in an inflorescence will be the lower sepal or sepals, the upper one or ones will be called posterior and the side ones lateral.

ANTHER, that part of the stamen which contains the pollen. In Angiosperms it usually consists of 4 cells, loculi or pollen-sacs (microsporangia), one pair on each side of the anther constituting the "anther-lobes." The cells or loculi often coalesce so that only 2 or even one cell is present in the ripe anther. When the loculi lie their whole length on the relatively broad connective, which then appears as a continuation of the filament, the anther is called *adnate*. When the filament appears to end at the base of the anther, the latter is called *innate*. If the anther swings freely on the top of the filament, it is called *versatile*.

ANTHERIDIUM, the organ in Cryptogams which produces the spermatozoids or male gametes.

APETALOUS, without petals or corolla.

APOCARPOUS, *see* Ovary.

ARCHEGONIUM, the organ which contains the ovum or oosphere. It typically consists of a narrow upper portion or neck leading to a basal dilated portion containing the oosphere. The spermatozoids reach the oosphere through a central canal in the neck and after fertilization the oosphere develops as the oospore.

ARCHESPORIUM, the cell or group of cells which give rise to the spores.

AREOLA, a space marked off from the rest or from the adjacent areolæ by some line, nerve or coloration.

ARIL, an envelope which grows up from the base of the seed and more or less completely covers it. It is usually fleshy, *e. g.* the flesh on the Litchi seed, the red covering on the Kujri (*Celastrus paniculatus*) seed.

ARISTATE, awned, or "when the point is fine like a hair," *Bth.* *See* Awn.

ASCENDING, becoming erect from a prostrate or sub-prostrate base.

ASEXUAL GENERATION, the spore producing generation, such as the fern, in contra-distinction to the fern prothallium. Syn. sporophyte.

ASPEROUS, rough with small papillæ.

ATROPHY, the partial or complete suppression of a member.

AURICLE, an ear-like appendage.

AWN, a rigid very fine or almost hair-like terminal appendage, *e. g.* the appendage on the ears of barley or the terminal twisted appendages of the Spear-grass.

AXIL, the upper angle formed by an axis and a lateral member, such as the angle formed by a leaf-stalk with the stem from which it springs.

AXILE, situated round an axis. Axile ovules are those situated on the column passing vertically through the centre of an ovary, which column may be either a free axis, or formed by the meeting of the internal walls of the ovary.

AXILLARY, situated in an axil.

AXIS. Any member which bears lateral subsidiary members may be called the axis of such subsidiary members.

BACCATE, berry-like.

BALSAM, a resin dissolved in an ethereal oil.

BARREN, *see* Fertile.

BARK, all the tissues alive or dead situated outside the cambium ring.

BASAL-NERVED, with several equally, or sub-equally, strong main or primary nerves starting from the base. Syn. palminerved, *cp.* Penninerved. *See also* Nervation.

BASIFIXED, fixed to the stalk at the base. *Cp.* Peltate, Dorsi-fixed, etc.

BASISCOPIC SIDE, the side of a lateral organ towards the base of the parent axis. *Cp.* Acroscopic.

BAST, a system of tissues distinct from the xylem or wood, and in Dicotyledons nearly always lying outside it, and separated from it by the cambium. The tissues of most economic importance in the bast are the *fibres* which yield such materials as jute, hemp, and other textiles.

BEAKED, provided with a firm excurrent solid or narrowly tubular prolongation which is often sharply marked off from the body of the organ. (The term is not applied to leaves.)

BERRY, typically a fleshy indehiscent fruit with many seeds. Sometimes, however, the seeds are few. The covering or pericarp consists of a thin skin or *epicarp*, a fleshy portion or *mesocarp*, and sometimes a firmer hard inner portion or *endocarp*. Where, however, the endocarp becomes stony or hard the fruit becomes a *drupe*. Examples of a berry are the Jamun (*Eugenia*), Mehrli (*Flacourtia*), Brinjal (*Solanum*). The term is sometimes extended to include fruits which are not typical berries but which resemble a berry in most characters.

BIFID, 2-fid, divided into 2 parts about half-way down.

BINATE, 2-nate, 2 arising together from the same point.

BI-PINNATE, pinnate with the pinnæ, or some of them, again pinnate.

BI-PINNATIFID, pinnatifid with the segments again pinnatifid.

BI-SEXUAL, 2-sexual, containing both fertile stamens and carpels with ovules.

BLADE, the expanded part of a leaf, bract, etc., as distinct from the stalk.

BOSTRYX or BOSTRYCHOID CYME, *see* Helicoid cyme.

BRACT, a reduced leaf. Bracts are usual on an inflorescence and often bear a flower in their axils.

BRACTEOLE, small bracts occurring on the axis of a next higher order than that on which the bract is situated. If bracts and bracteoles appear to arise from the same axis, the bracteoles will usually be in

a different position; thus in Dicotyledons if the bract is ventral the two bracteoles if present are usually lateral.

Buccina, a trumpet, horn. Hence bucciniform.

Bullate, raised between the nerves.

Caducous, quickly falling off.

Calycine, resembling a calyx in texture rather than petals.

Calyculus, (1) a calyx-like assemblage of minute leaves subsidiary to the true calyx and outside of it, or (2) a calyx-like organ, *e. g.* in some Loranthaceæ of which the morphology is doubtful, and may be a part of the torus.

Calyptrate, falling off as a cap without expanding, *e. g.* the corolla of many vines. Cap-like.

Calyx, the outer floral envelopes where these are two and differentiated into calyx and corolla. The term is also used where the inner floral envelope or corolla is considered as suppressed. *See* Flower, Perianth.

Calyx-tube, the tube or cup formed by the cohesion of the leaves of the calyx. Also loosely applied to an annular zone of the torus, which grows up and bears the calyx or sepals and frequently other members, such as petals, etc., on its edge. *See* Hypanthium. Where, *e. g.* in many *Combretaceæ*, etc., the hypanthium in an epigynous flower is produced into a tube beyond the ovary, this tubular portion alone is here referred to as a calyx-tube, the term hypanthium being exclusively used for the lower portion.

Campylotropous, *see* Ovule.

Canescent, *see* Hoary.

Capitate, (1) clustered together into a head or ball. (2) Knob-like.

Capitellate, in the form of a very small knob.

Capitulum, a head of flowers.

Capsule, a form of fruit which becomes dry when ripe and opens by two or more valves.

Carpel, the modified leaves which bear the ovules. The carpels occupy the centre of the flower when present (*e. g.* in female or hermaphrodite flowers) and together form the ovary (*q.v.*).

Carpophore, the axis of a ripe ovary from which the ripe carpels subsequently separate or are sometimes pendant.

Caruncle, a peculiar growth at the apical or micropylar end of the seed.

Catkin, a peculiar form of inflorescence consisting of an elongated axis clothed with bracts in the axils of which are 1- rarely 2-sexual flowers usually without, rarely with very inconspicuous, perianth. The whole inflorescence is deciduous together.

Caudate, furnished with a long slender tail-like tip.

Chartaceous, paper-like in texture.

-chotomous, divided several times into 2 (2-chotomous) or 3 (3-chotomous) forks.

Circinate, (1) rolled up longitudinally with a growing tip inside. (2) Coiled.

Cladode, a leaf-like branch of only one internode, *e. g.* the so-called "leaves" of Asparagus.

CLAVATE, club-shaped.

CLAW, the narrow or stalk-like base found in some petals.

COCCUS, one of the lobes of a fruit, each of which is usually derived from a single carpel of the ovary, and when ripe, becomes more or less detached from the other cocci. Cocci may be dehiscent or indehiscent.

-COCCOUS, adjective of the above used in composition, *e. g.* 5-coccous means composed of 5 cocci.

COLUMELLA, a term applied to the persistent axis of a fruit from which the rest of the fruit falls away in some cases when ripe.

COMMISSURE, the plane of division between two carpels in Umbelliferous fruits.

COMPLICATE, folded together lengthwise upon itself.

COMPOUND, composed of two or more similar parts; thus a compound leaf is composed of two or more separate leaflets, a compound inflorescence of smaller inflorescences.

CONNATE, united one to another. The term is used of similar parts only, such as sepal to sepal or petal to petal, etc., *e. g.* the petals of the Cotton plant; but the union of dissimilar parts, as, *e. g.*, petal to sepal, would be termed "adnate."

CONNIVENT, weakly cohering.

CONTORTED, a form of æstivation in which each member in a whorl has one margin overlapped by the preceding member, while the other margin overlaps the succeeding member. Sometimes called *overlapping* or *twisted.* The term "twisted" is here reserved for an actual twist which sometimes occurs in addition to overlapping.

CONVOLUTE, rolled up from one or both margins.

CORDATE, shaped like the conventional heart (as on playing-cards), or with the base heart-shaped.

COROLLA, one of the envelopes of the flower and a collective name for the petals. The corolla if present is usually situated within the calyx, but rarely the calyx is absent. It may usually be distinguished from the calyx not only by its position but by its peculiar texture and colour, *e. g.* the red petals of a rose, hence *corolline* or *petaloid.*

CORONA, a ligular outgrowth from the corolla or petals on the inside which sometimes appears like a second corolla, or a ligular outgrowth from the back of the stamens which may be interrupted between the stamens or continuous into a tube, *e. g.* in *Pancratium.*

CORIACEOUS, firm and dry, or very tough, leathery.

CRUSTACEOUS, firm and brittle, or very hard.

CORYMB, a form of inflorescence in which the several branches or flower-stalks arising at different levels reach more or less the same level at the top.

COSTA, COSTULE, *see* Nervation.

COTYLEDON, a leaf present on the embryonic plant while yet in the seed. The cotyledon (in Monocotyledons) or cotyledons (in Dicotyledons and Gymnosperms) in some species never expand but are absorbed by the germinating plant (hypogeal germination); in other species they appear above ground as the first green leaves of the plant (epigeal germination).

Cryptogam, a plant which does not form flowers and seeds in the ordinary sense of those words, though the aggregate of small sporophylls in Lycopods, etc., may be termed a *flower*.

Cusp, a short hard point or tip; sometimes also used in the sense of a short pointed tip from an otherwise obtuse leaf.

Cuspidate, (1) furnished with a cusp; (2) sometimes used as a short expression for abruptly acuminate. Bentham says "some botanists make a slight difference between acuminate and cuspidate, the acumen being more distinct from the rest of the leaf in the latter case than in the former." I think it better to use "cuspidate" only for a short sudden or hardened acumen.

Cyclic, with the parts arranged in whorls, not spirally.

Cyme, a system of branching in which the main axis ceases to grow or terminates in a flower; the secondary or lateral axes from beneath the apex continue to grow beyond the parent axis and may be likewise superseded by branches or axes of a higher order. *Cp.* Raceme.

Decandrous, 10-androus, with ten stamens.

Deciduous, falling off. *Cp.* Caducous.

Declinate, inclined to the lower side, and often ascending at the tip.

Decompound, repeatedly branched.

Decumbent, having the lower parts prostrate.

Decurrent, prolonged downwards from the base.

Decussate, in planes at right angles to one another.

Definite, not varying in number, not numerous.

Deflexed, bent downwards.

Dehisce, to open by the separation of the walls or valves.

Dehiscent, dehiscing when ripe.

Dentate, with teeth projecting more or less perpendicularly from the margin.

Denticulate, with little teeth, or points along the margin.

Diadelphous, 2-adelphous, in two bundles. A term applied to stamens which are grouped into two lots; one lot may, however, contain only one stamen.

Dichasium, a cymose method of branching in which each axis ends in a flower (or other short unbranched axis) from beneath which a pair of opposite lateral branches arise. Syn. Dichasial cyme.

Dichlamydeous = heterochlamydeous, or with two whorls of tepals.

Dichotomous, a method of branching in which each axis bifurcates at the tip.

Dicoccous, 2-coccous, consisting of two cocci.

Didymous, consisting of two equal or similar connected halves or lobes. In the case of anthers, the term is especially applied to those with two rounded lobes without separating connective.

Didynamous, in two unequal pairs.

Diffuse, loosely or widely spreading.

Digitate, spreading like the fingers of the hand. In the case of digitate leaves, each leaflet is properly provided with a short stalk

petiole; if this is absent the leaf is palmately-compound or palmati-rtite (*q.v.*).

DIMEROUS, 2-merous, with the parts in pairs.

DIMIDIATE, half wanting or rudimentary, or appearing to be so.

DIMORPHIC, occurring in two different forms. Syn. Dimorphous.

DIŒCIOUS, where the sexes occur on different individuals, the male wer on distinct plants from the female, as, *e. g.*, usually in the paya (*Carica*).

DIPLOSTEMONOUS, with the stamens in two whorls, those of the ter whorl opposite to the sepals, those of the inner whorl alternate th them.

DISC, a swelling or swellings, sometimes glandular, of the torus side the calyx and under or outside the pistil.

DISCIFORM, disc-like in the popular sense of the word "disc." so in the *Compositæ*, a flower head without ray flowers, *cp.* Radiate.

DISTICHOUS, disposed alternately in two opposite rows, or regularly arranged one above another in two opposite rows, one each side of the stem."

DISSECTED or DIVIDED, when the incisions between the segments st reach the midrib or petiole, but the parts or segments so divided do not separate from the axis without tearing. *Cp.* -sect.

DIVARICATE, spreading in opposite directions from a common se.

DORSAL, situated at the back of; in some senses the same as *sterior.* The dorsal part of a carpel is the part *remote* from the is of the ovary or axis of the flower produced. *Cp.* Ventral.

DORSIFIXED, fixed by the back of, in contrast to the state of being tached by the end or margin, etc.

DRUPACEOUS, more or less resembling a drupe.

DRUPE, a form of fruit consisting of a more or less succulent peri-rp which encloses a single 1–many-celled stone, *e. g.* a plum. The ne in a drupe is the inner portion, or *endocarp*, of the fruit, and is be distinguished from a hard seed *testa*. The stone may contain e or more seeds.

DRUPEL, each of the small drupes which may be formed from an ocarpous ovary, or the drupe-like lobes of a deeply divided fruit rived from a lobed but syncarpous ovary.

EBRACTEATE, without bracts.

ECHINATE, with long spreading spines.

ECOLOGY, *see* Œcology.

EDAPHIC, depending upon the nature and condition of the soil.

EFFUSE, a term applied to an inflorescence with loose widely-spread-g branches.

EMARGINATE, having a deep dent at the apex. If the dent is oader and shallower it becomes *retuse*.

EMBRYO, the new plant from the time of its inception in the fer-ized ovule and until the germination of the seed.

ENDOSPERM, the tissue formed within the embryo-sac or macro-ore subsequent to fertilization (in the case of Angiosperms) and stined to feed the embryo. In Gymnosperms the prothallium

(though a secondary endosperm may be also developed). *Cp.* Perisperm.

ENTIRE, with the margin or edges not toothed or cut but even and continuous.

EPICALYX, a whorl of bracts just beneath the calyx and in some respects resembling it; in other cases stipular appendages of the sepals which also resemble a secondary exterior calyx.

EPICARP, the outermost layer of the fruit.

EPIGEAL, when the cotyledons are raised above the ground free from the seed in germination and become leaf-like.

EPIGYNOUS, an epigynous flower is one in which the torus or receptacle grows up at the circumference (which now becomes a hypanthium), carrying with it the calyx, corolla and stamens and completely enclosing the ovary. An epigynous calyx, stamens, etc., refers to this superior position with regard to the ovary or pistil. *Cp.* Perigynous, Hypogynous.

EPIPETALOUS, situated on the corolla or petals. The position of epipetalous stamens may be either due to the growth of a common zone of the torus carrying with it both petals and stamens, or to the growing up together of both corolla and stamens (*i. e.* adhesion of corolla and stamens).

EPIPHYTE, a plant which grows upon another plant without, however, drawing its nutriment from the living parts of such other plant. *Cp.* Parasite.

EPISEPALOUS, (1) situated on the sepals. (2) Situated opposite to the sepals.

EQUITANT, in vertical rows with the bases of the outer sheathing the bases of the inner leaves, *e. g.* in many of the Iris Family.

ERECTO-PATENT, between erect and spreading.

EROSE, appearing torn or frayed at the edges.

EUSPORANGIATE, where the sporangia proceed from a group of epidermal cells and the archesporium is the hypodermal terminal cell of the axile row of cells of the rudimentary sporangium.

EVANESCENT, quickly disappearing.

EXALBUMINOUS, without albumen.

EXCURRENT, running out beyond the margin.

EXTRA-AXILLARY, situated away from the axil of the leaf to which it is nearest.

EXTRORSE, applied to anthers which open towards the circumference of the flower and not towards the pistil. Opposed to *Introrse.*

FALCATE, somewhat curved.

FALSE SEPTUM OR DISSEPIMENT, an inner wall of an ovary which is not formed from the incurved edges of the carpels and is usually of late development.

FASCICLED, closely aggregated.

FASTIGIATE, with the branches all upright.

FEMALE, a female flower is one which bears an ovary containing ovules capable of fertilization and becoming seed, and does not bear stamens. A flower which only bears an imperfect or functionless

ovary (pistillode) is not considered a female flower. A *female plant* is one which only bears female flowers.

FERTILE. A fertile flower is synonymous with a perfect female flower. A *fertile stamen* is one that develops functional pollen, in contradistinction to a staminode. A fertile frond in a fern is one that bears sporangia. Opposed to barren.

-FID, used in composition, divided about half-way down. *Cp.* -partite, -lobed, -sect. "If the leaves are cut into *lobes*, they are said to be pinnatifid, palmatifid, pedatifid, etc.," *Bentham's British and Colonial Floras.*

FILAMENT, the stalk of an anther, *i. e.* the lower part of a stamen, which may, however, be absent, in which case the anther is sessile.

FILIFORM, very slender, hair-like.

FIMBRIATE, clothed with narrow or filiform appendages.

FLABELLATE, fan-shaped.

FLESHY, thick and of somewhat firmer texture than succulent.

FLOWER, a collection of sporophylls or spore-bearing leaves (stamens or pistil) together with the usually more or less modified portion of the axis (torus, receptacle) on which they are inserted, and together with the specialized leaves (perianth, calyx, corolla), if any, which surround or envelope these organs.

A *typical* 2-sexual flower in Angiosperms consists of (*a*) two circles (whorls) of perianth leaves, the outer of which is green and herbaceous (calyx), the inner (corolla) white or coloured and of different texture (petaloid), (*b*) one or more whorls of male sporophylls (stamens), (*c*) one or more female sporophylls or carpels which bear the ovules. All or some of the above parts may be arranged spirally in some flowers, and any or all may be absent with the exception of a single stamen or a single carpel and the torus.

-FOLIOLATE, in composition refers to the leaflets in a compound leaf, *e. g.* 3-foliolate means with 3 leaflets.

FREE, not united with other members.

FREE CENTRAL PLACENTATION, where the ovules are situated on the axis of a unilocular ovary, which may be produced above the base of the ovary or not.

FROND, a term usually applied to the leaf of a fern.

FRUCTIFICATION, a fruit or aggregation of fruit, including such parts of the axis, bracts, etc., which are accrescent in fruit.

FRUIT, the ovary (in the case of an apocarpous ovary *all* the carpels) and its contents after the fertilization of the ovules, including in the case of inferior ovaries the accrescent hypanthium or investing part of the floral axis, *e. g.* apple. In Cryptogams, the collection of sporangia.

(*Note.*—Some botanists term each carpel of an apocarpous fruit a fruit.)

FRUTESCENT, becoming shrubby.

FRUTICOSE, shrubby.

FUGACIOUS, rapidly dying or falling off.

FUNICLE, the stalk by which the ovule is attached to the placenta of the ovary.

FURCATE, forked.

GAMO-, in composition means united or in one piece, *i. e.* not divided to the base into separate members, *e. g.* gamophyllous, with the perianth leaves united at least below, etc. The term is used even where perhaps the lower or tubular portion is an annular zone of the floral axis of the same texture as the leaves, petals, etc., concerned.

GEMINATE, in pairs.

GIBBOUS, swollen on one side ; humped.

GLABRATE, nearly glabrous.

GLABROUS, without any hairs.

GLABRESCENT, with deciduous hairs, becoming glabrous.

GLAUCOUS, of a blue-green colour.

GLUME, the bracts and bracteoles on the spikelets of the grasses and sedges.

GONOPHORE, an internode of the floral axis between the corolla and stamens, and hence bearing both the stamens and the pistil. *Cp.* Gynophore.

-GONAL, -GONOUS, in composition signifies -angled, *e. g.* 3-gonous. When acutely angled I have usually used the term "-quetrous."

GREGARIOUS, occurring associated in large quantities, *e. g.* the Sal tree.

GYNŒCEUM or GYNECIUM, the carpel, ovary or assemblage of carpels in a flower, together with their appendages (style, stigma).

GYNANDROUS, with the stamens adnate to the pistil.

GYNANDROPHORE, same as *gonophore.*

GYNOBASIC, arising from the base of the carpel or ovary.

GYNOPHORE, an internode of the floral axis between the stamens and the pistil, so that the pistil is considerably separated from the stamens. *Cp.* Gonophore.

HAIRY, clothed with somewhat long, not very dense hairs. *Cp. pubescent*, *villous*, etc.

HAPLOCHLAMYDEOUS, with only one whorl of perianth leaves.

HAPLOSTEMONOUS, with only one whorl of stamens.

HASTATE, shaped like an arrow-head in which the barbs, basal lobes or auricles spread more or less at right angles to the rest of the blade.

HELICOID (CYME), a form of sympodial cymose branching in which the newer axis always arises to the same side of the parent axis, so that the sympodium becomes more or less spiral, *e. g.* each half of a pedate leaf. Syn. Bostrychoid.

HEMICYCLIC, with some of the floral members whorled or cyclic and others spiral, *e. g.* with the calyx and corolla in whorls and the stamens and carpels spirally arranged as in *Clematideæ.*

HEMIPARASITE, partially parasitic. Hemiparasites have green leaves and thus form starch, etc., for themselves. Holoparasites are completely parasitic.

HERMAPHRODITE (flower), a flower in which both stamens and ovary are present and functional.

HETEROCHLAMYDEOUS, with the perianth distinctly differentiated into a calyx and a corolla.

HETEROGAMOUS, a term usually restricted to the flower-heads of the *Compositæ* and the spikelets of grasses where the flowers are of two kinds differing in sex in the same head or spikelet, *i. e.* some male, female, hermaph. or neuter flowers, or any two or three of these, are included in the same head.

HETEROSPOROUS, bearing spores of different kinds. *See* Spore.

HILUM, the scar on a seed indicating the point of separation from the funicle or stalk.

HIRSUTE, with a thick covering of somewhat firm, moderately long and spreading hairs. *Cp.* Hairy, Pubescent, Villous, etc.

HISPID, with short scattered very stiff hairs or bristles; sometimes the base of the hair only is stiff. A hispid surface feels harsh to the hand.

HOARY or CANESCENT, when the hairs are so short as not to be distinguished by the naked eye and yet give a general whitish or grey hue to the surface.

HOMOGAMOUS, a term usually restricted to the flower-heads of the *Compositæ* and the spikelets of grasses where the flowers are all similar to one another in sex in the same head or spikelet, *i. e.* either all male, all female, or all hermaph.

HOMOIOCHLAMYDEOUS, where the different whorls or members of the perianth or floral envelopes are all similar in texture, *i. e.* not distinctly differentiated into calyx and corolla. *Cp.* Haplochlamydeous, Heterochlamydeous.

HOMOLOGOUS, of similar morphological significance.

HYGROPHYTE, a plant requiring a constant supply of moisture all the year round.

HYPANTHIUM, a more or less tubular or flask-shaped zone of the floral axis which grows up above the level of the ovary and bears on its margin or at different levels the floral envelopes and andrœcium. It is sometimes constricted above the ovary and prolonged into a "beak" above it. It is either green or coloured, specially in fruit. The ovary may lie free within it or be closely invested by (adnate to) it, in which case it may be referred to as the ovary-wall. *See also* Calyx-tube.

HYPOGEAL, germination in which the cotyledons remain in the seed.

HYPOGYNOUS, situated on the torus at the same level as, or below the level of the base of the ovary. *Cp.* Perigynous, Epigynous.

IMBRICATE, a mode of æstivation in which one member of the whorl is outside all the others (*i. e.* its margins are free) and one inside all the others (*i. e.* both margins are overlapped); the others usually overlap by one margin only. Also used for leaves, etc., where they overlap one another like the tiles of a house.

INCISED, deeply cut.

INCURVED, with the ends curved inwards or towards the axis.

INDEFINITE, of varying number and usually numerous.

INDEHISCENT, not opening by valves or pores. The liberation of the seeds of an indehiscent fruit takes place through the consumption of the fruit by animals, or through the rotting or irregular rupturing of the walls of the pericarp.

INDUMENTUM, the clothing of hairs, scales, etc.

INDUPLICATE, rolled inwards on both sides.

INFERIOR, an inferior calyx, stamens, etc., implies insertion at a level below, or near, the base of the ovary ; an inferior ovary implies that the sepals, stamens, etc., are inserted on the torus at a level above or near the top of the ovary. *Cp.* Epigynous.

INFLORESCENCE, an axis or assemblage of axes especially devoted to the bearing of flowers and including the flowers and their bracts and bracteoles.

INFRUTESCENCE, an assemblage of fruits including in many cases the more or less modified axes which bear them.

INFUNDIBULAR, funnel-shaped, having the lower part tubular and gradually widening upwards, as in a chemical funnel.

INNATE, said of stamens in which there is a distinct transition from, or articulation between, the anther and the filament, in contradistinction to one in which the connective appears merely as a continuation of the filament. *Cp.* Adnate. In some cases, however, *e. g. Dimorphocalyx*, the whole anther may be innate but its cells adnate to a thick connective.

INTEGUMENT, one of the coats or envelopes of the nucellus of the ovule. There may be one or two integuments which grow up from the base of the ovule completely investing the nucellus with the exception of a minute channel at the tip termed the *micropyle*, through which in most plants the pollen-tube finds its way to the embryo-sac.

INTERNODE, the space between two leaves or metmorphosed leaves.

INTERPETIOLAR, said of stipules situated between the bases of opposite leaves, and which are frequently more or less connate, so that each pair, made up of one from each leaf, may resemble single stipules.

INTRAPETIOLAR, said of stipules when each pair of a single leaf unite together within the axil of the leaf.

INTRORSE, said of anthers which open towards the pistil. *Cp.* Extrorse.

INVOLUCRE, an assemblage or whorl of bracts or leaves situated close beneath a flower or inflorescence.

IRREGULAR, unsymmetrical, *i. e.* not being capable of division into two similar halves or only by a single plane passing through the axis (zygomorphic). Sometimes also used for flowers in which some of the members in the same whorl differ from others.

ISOMEROUS, with the number of members in each whorl the same.

ISOSPOROUS, *see* Spore.

ISOSTEMONOUS, with the stamens equal in number to the normal number of the sepals, petals or (in haplochlamydeous flowers) tepals.

-JUGATE, in composition in .... pairs, *e. g.* multijugate = in many pairs.

KEEL, the anterior petal in the *Papilionaceæ* ; a ridge shaped like the keel of a boat as in the adjective " keeled."

LACINIATE, irregularly cut into very narrow lobes.

LANCEOLATE, shaped like a lance-head. A lanceolate leaf may or may not taper as much at the base as at the other end, but if it is

much wider near the base the leaf will become ovate-lanceolate. It is usually at least three times as long as broad.

LATERAL, situated to the right and left of the median plane. *See* Anterior.

LATEX, milky juice. Laticiferous, possessing latex.

LEAF, leaves in the broad morphological sense are lateral exogenous outgrowths of an axis originating below the growing apex in acropetal succession from the undifferentiated tissue of the growing point, and differing in form from the axis which produces them.

In its typical form a leaf consists of a flat expanded green blade, or in a compound leaf several blades (*leaflets*), a stalk or *petiole*, and two lateral appendages at or near the base of the petiole (*stipules*). Any of these parts may be absent or the leaf variously metamorphosed into foliar tendrils, bracts, scales, petals, etc.

The growth and life of a leaf is usually strictly limited, it never bears flowers, but it often bears sporangia (as in ferns, carpels, stamens). It often bears a bud or shoot in its axil except in the case of many metamorphosed leaves. In descriptions of shape, etc., the word *leaf* merely denotes the blade of the ordinary foliage leaves.

LEAFLET, one of the blades of a compound leaf (see above). A leaflet may usually be distinguished from a simple leaf from its position (one very frequently terminating the foliar axis), and from bearing no bud in its axil.

LEGUMINOUS, resembling the peas and beans, especially in the nature of the fruit.

LENTICEL, cortical pores. Usually lens-shaped or elongate small dots or excrescences on the bark; they are filled with loose tissue, the intercellular spaces of which serve as a passage for oxygen into the inner tissues.

LEPIDOTE, covered with small flat scales.

LEPTOSPORANGIATE. The sporangia are formed from a single epidermal cell, and have a peculiarly shaped, usually tetrahedral archesporium.

LIGULE, a membranous or petaloid outgrowth from the surface of an organ. In grasses and many other monocotyledons the membranous appendage at the mouth of the sheath.

LIGULATE, strap-shaped.

LIMB, the expanded part of a corolla, petal, etc., in contra-distinction to the tube or claw.

LINEAR, at least four or five times as long as broad.

LOBED, cut less than half-way down into (unless otherwise specified) more or less rounded segments. Lobed or cleft, "so that the incisions do not reach the midrib or petiole," *Bentham*. Bentham evidently uses the word "lobes" and "-fid" in a more extended sense than is usually done. He says that bifid, trifid, multifid, mean two-lobed, three-lobed, etc.

-LOCELLATE, used in composition to indicate the number of locelli or cells in an anther, especially before the fusion which often takes place on dehiscence.

-LOCULAR, used in composition to indicate the number, etc., of cells or compartments in an ovary or fruit, or in a ripe anther just before dehiscence.

LOCULICIDAL, a mode of dehiscence in which rupture takes place through the middle of the outer wall of each cell or loculus. *Cp.* septicidal.

LOCULUS, a compartment of an ovary, anther, fruit, etc.

LODICULE, small scales, usually much swollen at the time of flowering, occurring in the flowers of many grasses, and by some supposed to represent the inner whorl of a rudimentary perianth. They appear to have the function of forcing apart the glumes.

LYRATE, with a very large terminal lobe compared with the smaller and narrower lateral lobes in a pinnatifid leaf.

MACROSPORANGIUM, a sporangium which contains one or more macrospores. In the Gymnosperms and Angiosperms the macrosporangium is represented by the nucellus of the ovule.

MACROSPORE, a relatively large asexually produced female spore, *i. e.* a spore producing a prothallium which bears archegonia but not antheridia, represented in the Angiosperms and Gymnosperms by the embryo-sac.

MALE FLOWER, a flower which bears fertile stamens but not fertile carpels. An abortive pistil may be present in a male flower or not.

MARCESCENT, remaining attached after flowering, usually in a withered or altered state.

MARGINATE, with a margin of a different character from the rest of the member.

MEDIAN, lying in the plane drawn through the centre of the member and the longitudinal centre of the axis bearing the member.

MEGASPORE. Syn. Macrospore.

MERICARP, one-half of a schizocarpous fruit.

-MEROUS, in composition, indicates the number of members in each whorl, *e. g.* 5-merous.

MICROSPORANGIUM, a sporangium which contains microspores. In the Gymnosperms and Angiosperms each loculus of an anther is a microsporangium.

MICROSPORE, relatively small asexually produced spores, which give rise to a prothallus bearing antheridia. In the Gymnosperms and Angiosperms the pollen-grains are the microspores.

MICROPYLE, the canal through the integuments of an ovule at the apex of the nucellus.

MIXED FOREST, forest composed of a large number of different species rather than of one or two gregarious species.

MONOCARPIC, dying after one flowering season, *e. g.* some Palms. If, after flowering, the whole or part of a plant lives and produces flowers in another season it is caulocarpic.

MONADELPHOUS, more or less united into one bundle by the filaments.

MONOCHLAMYDEOUS, a flower with only one kind of floral envelope not differentiated into calyx and corolla (although possibly in two whorls, as in some *Lauraceæ*). Syn. homoiochlamydeous.

MONŒCIOUS, bearing both male and female flowers on the same individual, *e. g.* many *Cucurbitaceæ.*

MUCRONATE, tipped with a very short hard, usually blunt point. If the point is longer or acute it becomes cuspidate or awned.

MURICATE, covered with scattered short firm thick or conical spines.

MUTICOUS, without appendages.

-NATE, used in composition, arising from the same point or whorled, *e. g.* binate in pairs, ternate in threes.

NERVATION, the arrangement of the fibro-vascular bundles in the leaves. The method of describing the nervation differs somewhat in the Flowering Plants and Ferns.

I. *Flowering Plants.*—The nerves or ribs which spring directly from the petiole (or stem in sessile leaves) are termed *primary nerves.* The centre one, or if there is only one, is the *mid-rib.* If there are several primary nerves spreading from the base the leaf is *palmi-nerved* or palmately nerved; 3-nerved, 5-nerved, etc., refer to the number of primary nerves. If all the primary nerves are parallel or nearly so the leaf is *parallel-nerved.* The larger nerves which spring laterally from the primary nerves are the *secondary nerves,* and those that arise from these the *tertiary nerves,* which may, as well as the nervation of a higher order, be also called the nervules. If the nervules are very numerous and anastomose with one another the nervation is *reticulate,* but this expression is sometimes also used merely as the antithesis of *parallel-nerved.*

II. *Ferns.*—The continuation of the stipes or stalk of the frond into the blade is called the rhachis or primary rachis in a compound or deeply divided frond, rhachis or mid-rib or costa in a less divided or simple frond. The branches from the primary rhachis in a bi-many-pinnate or deeply 2–many-pinnatifid frond are the *secondary rachides,* and the branches from these again the tertiary rachides, according to the state of division of the frond. The mid-rib of a final lobe or segment is a costule. The nerves that spring from the costæ of a simple frond or the costule of a segment are the *veins,* and those of a higher order the venules or veinlets.

NODE, the plane of insertion of a leaf on the axis.

NUT, a hard, dry, 1-seeded indehiscent fruit.

NUTLET, the dry 1-seeded lobes of some fruits, each of which becomes detached like a separate fruit, *e. g.* in *Labiatæ* and *Borageæ.* *See also* Coccus.

OB-, in composition means inversely. Thus an ovate leaf has the wider part towards the base, an *obovate* leaf is inversely ovate and has the wider part towards the apex.

OBDIPLOSTEMONOUS, diplostemonous in which the members of the outer whorl of stamens are opposite to the petals, and those of the inner whorl opposite to the sepals.

OBLIQUE, when referring to shape means with one half more largely developed than the other.

OBLONG, longer than broad and with the sides more or less parallel.

OBSOLETE, not developed.

OBTUSE, blunt but scarcely rounded.

OCREATE or OCHREATE, said of stipules which are united into a tube round the stem.

ŒCOLOGY, the science of the relations of an organism to its environment.

OOSPHERE, a naked nucleated mass of protoplasm, which after coalescence with the nucleus of the spermatozoid becomes the *oospore* and embryo of the succeeding generation.

OOSPORE, *see* Oosphere.

OPPOSITE, on different sides of the axis with the bases on the same level.

ORTHOTROPOUS, an orthotropous ovule is straight with the micropyle opposite to the chalaza or base from which arise the integuments. *Cp.* Anatropous. *Vide also* Ovule.

OVAL, broadly elliptical.

OVARY, the part of a flower which contains the ovules, and consisting of one or more carpels which cohere by their edges to form one or more closed cells or chambers, the *cells* of the ovary. An ovary is *apocarpous* if the carpels composing it are free from one another, in which case each carpel forms a separate chamber by the incurving and meeting of its edges (*see* Suture). An ovary is *syncarpous* if the carpels composing it are united to one another. A syncarpous ovary is 1-celled where the component carpels only cohere by their edges or where the coherent edges are incurved without reaching the axis; it is 2- or more-celled where the coherent edges of the carpels are sufficiently incurved to meet one another in the axis of the ovary, so as to form walls, or *septa*. Septa sometimes arise also by vertical walls between the axis of the ovary and the mid-ribs of the carpels, or in a 2-carpellary ovary by a wall joining the sutures. These are sometimes called *false septa*.

OVATE, egg-shaped with the broader end towards the base scarcely twice as long as broad.

OVATE-LANCEOLATE, OVATE-OBLONG, etc., between ovate and lanceolate, between ovate and oblong, etc.

OVULE, usually small or minute bodies attached to the carpellary leaves (carpels) in most Gymnosperms, and usually to the carpellary leaves, but sometimes on the base or on the free axis of the ovary in the Angiosperms, always in the Angiosperms inside the closed ovary. The ovule consists of a central portion (macrosporangium, nucellus) and nearly always of one or two integuments which envelop the nucellus by growing up from its base. It is attached by a stalk, *funicle*, to the placenta or is more rarely sessile. If the ovule and nucellus are straight with the micropyle opposite to the base (chalaza) the ovule is *orthotropous ;* if it is inverted so that the funicle is adnate to the side (forming the *raphe*) and the micropyle is directed towards the placenta it is *anatropous ;* in this case the nucellus remains straight between the chalaza and the micropyle, but if the whole ovule including the nucellus is itself curved the ovule is *campylotropous*. In this case the embryo also becomes curved. On fertilization and consequent development of the embryo the ovule becomes the *seed*.

PALE or PALEA (adj. paleaceous), a chaffy scale. Specifically the upper of the two bracts which subtend a flower in the *Gramineæ*. The palea of the *Gramineæ* is most frequently 2-nerved and may possibly represent two connate tepals of the outer perianth whorl.

PALMATE, with the segments radiating like the spread fingers of the hand. A palmate leaf may have the segments cut to the base, in which case it becomes compound, but if the leaflets are petioluled it is called *digitate*.

PALMATIFID, palmate with the sinuses reaching about half-way down.

PALMATIPARTITE, palmate with the sinuses reaching beyond the middle.

PALMATISECT, much cut in a palmate manner.

PALMINERVED, with the primary nerves radiating from the apex of the petiole.

PANDURIFORM, fiddle-shaped, with the base and end broader than above the base.

PANICLE, a repeatedly branched inflorescence.

PAPILIONACEOUS, shaped somewhat like the flowers of a pea or bean. A typical papilionaceous flower has a corolla with a large posterior petal (*standard*), two lateral petals (alæ, *wings*) and two anterior petals more or less combined into a *keel*.

PAPILLÆ, small multicellular outgrowths from the epidermis.

PAPPUS, the scaly, hairy or feathery modified calyx of the fruit of some plants, especially of the *Compositæ*.

PARALLEL-NERVED, with numerous nerves from the base running more or less parallel and close to one another, as *e. g.* in the leaves of Bamboos, etc.

PARASITIC, drawing sustenance from the living tissues of other plants. *Cp.* Epiphytic, saprophytic.

PARI-PINNATE, pinnate with the leaflets in pairs and no terminal leaflet.

-PARTITE, in composition means cleft considerably beyond the middle. *Cp.* -fid, -lobed.

PECTINATE, with narrow segments spreading like the teeth of a comb.

PEDATE, a form of branching in which the segments of each half of the leaf form a helicoid cyme.

PEDICEL, a small stalk. Especially the stalk of a single flower of an inflorescence to distinguish it from the peduncle.

PEDUNCLE, the stalk of an inflorescence, or of a single flower when the inflorescence is 1-flowered, or the common stalk of two or more pedicelled flowers.

PELLUCID, translucent.

PELTATE, (1) shield-shaped, round, like the indusium of some ferns; (2) of leaves, attached to the petiole in the centre of the blade, or at least not by the margin.

PENNINERVED, with one mid-rib and secondary nerves branching from it. *Cp.* Nervation, Basal-nerved.

PENTADELPHOUS, applied to stamens aggregated into 5 groups.

PENTAMEROUS, with 5 members in each whorl.

PERIANTH, a general term for the floral envelopes including both calyx and corolla, but more especially when there is no differentiation into calyx and corolla.

PERICARP, the whole wall of the fruit including the epicarp, mesocarp and endocarp.

PERIGYNOUS, a term applied to the flower or to the sepals, petals, or stamens when these are raised on a zone (hypanthium) of the torus above the level of the base of the ovary when the ovary is free in the tube so formed or only adnate by means of the intercalated disc. *Cp.* Hypogynous, Epigynous.

PERISPERM, nutritive tissue of the nucellus *outside* the embryo-sac, which remains in the seed until absorbed by the *germinating* embryo. Most dicotyledonous seeds contain endosperm but not perisperm.

PERSISTENT, not falling off.

PERULATE, wrapped in scales, as many winter buds.

PETAL, one of the divisions of the corolla.

PETALOID, of a more or less delicate texture and white or coloured. *See* Corolla. *Cp.* Sepaloid.

PETIOLE, the stalk of a leaf.

PETIOLULE, the stalk of a leaflet in a compound leaf.

PHYLLOCLADE, a branch compressed so as to resemble a leaf and performing the functions of a leaf. *Cp.* Cladode.

PHYLOGENY (adj. phylogenetic), (1) ancestry from forms or groups which differ specifically, or generically, or in more important characters, from the existing species or group. (2) Opposed to *ontogeny*, or the origin and development of the individual.

PILOSE, covered with rather long, not matted nor very silky hairs. "Thinly sprinkled with rather long hairs," *Bth.*

PINNA, the branches of a bi-pinnate leaf. *See* Pinnate.

PINNATE, a compound leaf with two or more leaflets springing from each side of the axis or *rachis*. If the leaflets are odd so that the rachis terminates in a leaflet, the leaf is imparipinnate; if the leaflets are even with no terminal leaflet, the leaf is paripinnate. If the rachis of the leaf bears one or more pairs of secondary rachides which latter bear the leaflets, the leaf is *bi-pinnate*. If the secondary rachides bear again rachides the leaf is *tripinnate*, and so on.

PINNATELY, in a pinnate manner, *i. e.* with the branches springing from either side of the central axis. *Cp.* palmate (adv. palmately).

PINNATIFID, deeply lobed to about half-way down or more with the lobes pinnately arranged.

PINNATISECT, pinnatifid down to the mid-rib. *Cp.* Dissected.

PINNULE, the ultimate free divisions or leaflets of the frond in ferns.

PISTIL, a collective word for the ovary, style and stigma.

PISTILLODE, a rudimentary pistil.

PLACENTA, the surface to which are attached the ovules.

PLACENTATION, position of the placenta.

PLICATE, plaited.

PLUMOSE, feathered.

PNEUMATOPHORE, organs for admitting oxygen to the roots in some swamp plants.

POD, typically a dry fruit derived from a mono-carpellary ovary, elongated in shape and dehiscing along one or both sutures, such for instance as a pea-pod. In a more extended sense any fruit of the Leguminous order or other fruit resembling a typical Leguminous fruit.

POLLEN, the male spores which are developed in the pollen-sacs or loculi of anthers.

POLYADELPHOUS, in many bundles.

POLYGAMOUS, bearing male, female and hermaphrodite flowers on the same plant.

POSTERIOR, *see* under Anterior.

POSTICOUS, hinder, at the back, posterior.

PRICKLE, a pointed spine-like process originating from the epidermal, or epidermal and subjacent, tissue only. *Cp.* Thorn.

PRIMARY NERVES, *see* Nervation.

PROCUMBENT, when the branches spread along the ground the whole or greater portion of their length. *Cp.* Ascending.

PROSTRATE, when they lie *close* to the ground.

-PLINERVED, when several primary nerves diverge from close to the base but the lateral ones diverge from the mid-rib a *little above* the base.

PROTANDROUS, the anthers ripening before the pistil is ready for fertilization. Syn. Proterandrous.

PROTHALLIUM, prothallus, the plant produced direct from a spore. *q.v.*

PSEUDOCARP, a fruit or cluster of fruits together with the accrescent axis, peduncle or other parts not usually considered to belong to the fruit proper, *e. g.* a pine-apple.

PUBERULOUS, slightly pubescent. Syn. Puberulent.

PUBESCENT, covered with close short fine hair. Pubescence is a denser shorter state of hairiness than hairy.

PUNCTATE, marked with small dots or points.

PUNGENT, with a pin-like point capable of penetrating the flesh.

PUTAMEN, the hard endocarp, especially a many-celled endocarp, of fruits.

PYRENE. When a putamen consists of or breaks up on ripening into several parts each enclosing a seed, each such part is called a pyrene. *Cp.* Coccus.

-QUETROUS, in composition = -cornered or -angled. In this Flora 3-quetrous signifies more sharply 3-angled than 3-gonous.

QUINATE, with 5 segments or leaflets.

RACEME, an inflorescence in which the main axis continues to grow and the lowest flowers are the oldest and open first.

RACEMOSE, a form of branching in which the main axis continues to grow and remain stronger than the lateral axes, which successively spring from it, with the youngest nearest the apex. *Cp.* Cyme.

RACHIS or RHACHIS, (1) that part of a pinnate leaf which bears the leaflets; in a bi-pinnate leaf the primary rachis bears the pinnæ, the secondary rachides the leaflets. (2) The axis of an inflorescence.

RACHILLA OR RHACHILLA, the axis of the spikelet of grasses or sedges.

RADIATE, bearing ray flowers of a different form to the inner flowers of an umbel or capitulum.

RADICAL, direct from the root.

RADICLE, the embryonic root.

RAPHE, the ridge or course of the funicle along the side of some ovules, the funicle being adnate in anatropous ovules. *q.v.*

RAPHIDES, acicular crystals sometimes found embedded in tissues, and in some cases visible as small raised lines on the surface.

RAY FLORETS OR RAY FLOWERS, the more or less zygomorphous flowers found at the circumference of many umbels, flower-heads, etc.

RECEPTACLE, the portion of the axis on which is situated the florets in a capitate inflorescence, or on which is situated the parts of the flower in a flower.

REGULAR, with all the members symmetrically disposed around the geometric centre of the flower, and with either all the members in a single whorl equal and similar, or if dissimilar then regularly alternating.

RENIFORM, kidney-shaped.

REPAND, with a wavy margin, the sinuses being more shallow than in *sinuate*.

REPLUM, a partition of the ovary which is not a part of the carpels. A septum joining the sutures of the two carpels in *Cruciferæ* and some other families, from which the carpels or valves finally separate.

RETINACULUM, an upcurved acute subsequently hardened process from the placenta (possibly a modification of the funicle) on which the ovules and seeds are borne in most *Acanthaceæ*.

RETRORSE, directed backwards.

RETUSE, with the apex depressed so that there is a sinus at the tip, which is less deep than emarginate; "very obtuse or truncate, and slightly indented," *Bentham*.

RHACIS, RHACILLA, *see* Rachis, Rachilla.

RHIZOME, an elongated underground stem with usually horizontal growth.

ROOTSTOCK, *see* Stock.

ROTATE, a corolla with a very short tube and a horizontally spreading limb, or tube 0.

ROTUND, roundish; not angular.

RUGOSE, with numerous minute elevations and depressions.

RUMINATE, with the testa of the seed projecting as points and plates into the albumen.

RUNCINATE, incised with the lobes directed backwards.

SACCATE, bulged into a small sac or cavity.

SAGITTATE, arrow-shaped with the basal lobes directed backwards. *Cp.* Hastate.

SALVER-SHAPED, with a long tube and horizontally spreading limb.

SAMARA, a fruit with the pericarp compressed and expanded into a wing, or each part of a schizocarpous fruit in which the pericarp is thus modified.

SAPROPHYTE, a plant which feeds upon decayed organic matter.

SARMENTOSE, with long arching slender branches which are often subscandent.

SCABRID, covered with small hard hairs or points so as to feel rough to the touch.

SCABROUS, very scabrid.

SCAPE, a peduncle which rises direct from the root.

SCARIOUS, dry and membranous.

SCHIZOCARP, a fruit which splits up into two or more distinct portions (mericarps, cocci, etc.) each with its own wall.

SCLERENCHYMATOUS, applied to tissue, consisting usually of more or less isodiametric cells, in which the cell walls are very greatly thickened and hardened.

SCORPIOID, with the (apparently) lateral axes forming a double row on one side of the usually curved (apparent) main axis or sympodium. Hole's definition differs. He says the lateral branch develops alternately on opposite sides.

-SECT, in composition means deeply cut, especially cut nearly to the axis. *See* Dissected.

SECUND, all inclined in one direction.

SEED, the ovule after fertilization and development of the embryo. The seed consists of the more or less modified integuments of the ovule which become the *testa* or seed coat (*see also* Aril, Arillus), sometimes also a part of the tissue of the nucellus, which becomes filled with food material (perisperm), frequently a tissue which has become developed inside the embryo-sac (endosperm), and finally the more or less completely developed and differentiated embryo. *See* also Introduction (*Spermophyta*), p. 89.

SEPAL, one of the divisions of the calyx, texture usually herbaceous.

SEPALOID, green and resembling a sepal in texture rather than a petal. *Cp.* Petaloid.

SEPTICIDAL, a mode of opening of a fruit by means of a split through the median plane of the interior walls or dissepiments, so that the fruit becomes more or less separated into its component carpels, but these are not closed as in cocci, and the seeds escape either by dissolution of the inner part of the septum or by the ventral suture, with separation of the carpels, which usually begins by an opening at the top of the fruit. *Cp.* Loculicidal.

SEPTIFRAGAL, a mode of dehiscence in which a central column bearing the septa or part of the septa remains while the exterior walls of the fruit and often part of the septa separate from it. *E. g.* in *Elatinaceæ* the valves separate from the whole axis and septa. *Cp.* Loculicidal, Septicidal.

SEPTUM, an interior wall.

SERRATE, toothed like a saw with the teeth inclined forwards.

SERRULATE, serrate but with the teeth very minute.

SESSILE, without a stalk.

SETA, a long stiff hair. Setaceous, needle-like; very slender and tapering, and of no appreciable width; more slender than in linear. "Very slender like bristles or hairs," *Bth.*

SETOSE, beset with setæ.

SEXUAL GENERATION, *see* Spore.

SILKY, sericeous, covered with very fine adpressed silky hairs.

SIMPLE, not composed of a number of similar parts, opposed to compound. A leaf is *simple* even if segmented provided that the divisions are not separated by portions of the axis destitute of blade.

SINUATE, somewhat deeply waved. *Cp.* Repand.

SORUS, a group of sporangia, sometimes covered by an indusium.

SPATHE, a large bract which sheaths an inflorescence or part of an inflorescence, at least, in its young state.

SPATHACEOUS, resembling a spathe, sheathing and not divided up into distinct sepals, petals, etc.

SPICATE, spiked, with the flowers in a spike. *q.v.*

SPICIFORM, resembling a spike in appearance.

SPIKE, a form of racemose inflorescence in which the flowers are sessile on the axis.

SPADIX, a spike with an enlarged fleshy axis and usually enclosed when young in a *spathe.*

SPIKELET, the ultimate parts of the inflorescence of grasses (rarely an inflorescence consists of only one spikelet) and *Cyperaceæ* are called spikelets. A spikelet in the grasses consists of an axis (rachilla) with usually three or more distichously arranged bracts (glumes), of which the lowest two (one or more) are usually empty and the others contain an opposing bracteole (pale) and a male or female or 2-sexual naked flower. *See* also Glume, Pale, Lodicule.

SPORANGIOPHORE, the part of a stem or branch bearing sporangia.

SPORANGIUM, a special sac in the inside of which are produced the spores.

SPORE, a single cell with usually a rounded firm wall, capable of germination and producing another individual. This individual is not always of the same form as that which produced the spore, and in the Vascular Cryptogams is known as the *prothallium.* The prothallium bears sexual organs, female (archegonia) or male (antheridia), and is hence known as the *gametophyte* or sexual generation. Inside the archegonium is produced after fertilization an *oospore,* which finally gives rise to the embryo of a new spore-bearing generation. Spores may be either all similar (*isosporous*) or dissimilar (*heterosporous*). In the former case the prothallia are usually 2-sexual; in the latter case the smaller spores (microspores) produce antheridia-bearing prothallia only; the larger spores (macrospores) produce archegonia-bearing prothallia only. *See also* Introduction, pp. 85–89.

SPOROCARP, small round bodies with firm walls, which contain several sporangia. They are found more especially in the *Hydropterideæ,* and are probably very much metamorphosed leaf segments.

SPOROPHYLL, a leaf or metamorphosed leaf which bears the sporangia either on its surface or in its axil. A number of symmetrically arranged sporophylls on a special receptacle, such as stamens and carpels in an Angiosperm, forms a flower in the most general sense of the word.

SPOROPHORE, the asexual or spore-producing generation, opposed to the Gametophyte or sexual generation. *See* Spore.

SQUARROSE, with numerous close-set spreading leaves, bracts, or tips or processes of leaves, bracts, etc.

STAMEN, a modified leaf or sporophyll in the flowering plants which bears the microsporangia or pollen-sacs. A typical stamen consists of a stalk (filament) and the specially modified blade (anther) which bears the pollen-sacs. *See also* Anther.

STAMINODES, imperfect or reduced or rudimentary stamens which do not bear fertile pollen.

STELLATE, spreading in a star-shaped manner.

STIGMA, the part of a carpel especially adapted by means of papillæ, viscosity, etc., to receive the pollen-grains. The stigmas of the several carpels forming an ovary may be separate or united, stalked or sessile.

STIPES, a stalk, especially the stalk of a fern leaf.

STIPELLA, the stipule of a leaflet.

STIPITATE, stalked.

STIPULE (adj. stipular). Stipules are a pair of processes (often absent), one of which springs from either side of the leaf-base (*i. e.* where the stalk of a leaf or the base of a sessile leaf leaves the stem). They are either membranous or foliaceous in texture, usually small but sometimes exceeding the leaf-blade (which they often protect) in bud.

STOCK, it includes a small portion of the summits of the previous year's roots as well as of the base of the previous year's stems. The under-sides will emit new roots. These perennial stocks only differ from the permanent base of an undershrub in the shortness of the perennial part of the stems and in the texture usually less woody. Where the stock is entirely underground it is called the *rootstock*.

STOLON, a slender stem usually furnished at first with scale-leaves only, springing from the root or base of the stem and extending some distance under or on the ground, ultimately rooting and giving rise to a new plant.

Strophiole, a thickening about the hilum or base of a seed, perhaps of the nature of an incomplete aril.

STYLE, a slender outgrowth or appendage of a carpel and bearing the stigma. The style may be absent. In an ovary of more than one carpel the separate styles may be distinct or more or less connate into one; in the latter cases the stigmata may be distinct or fused.

SUBULATE, awl-shaped, *i. e.* slender and tapering to a point.

SUCKERS, young plants formed at the end of creeping, underground rootstocks. (2) Plants formed from adventitious root-buds.

SUCCULENT, soft and juicy. *Cp.* Fleshy.

SUFFRUTESCENT, somewhat shrubby.

SULCATE, grooved.

SUPERIOR, situated above another member. A superior ovary has its base above the insertion of the calyx; a superior calyx is inserted at a level above the top of the ovary.

SUTURE, a seam, the line marking the connate edges of a carpel (ventral suture) and sometimes also the line marking the mid-rib of the carpel (dorsal suture).

SYMPODIUM, an apparent main axis made up of the superposed lower parts of successive lateral axes.

SYNANGIUM, a number of sporangia growing together so as to appear as loculi of a single aggregate.

SYNCARPOUS, *see* Ovary.

SYNANDROUS, with the stamens united throughout into a column.

SYNGENESIOUS, with the anthers cohering.

TENDRIL, a filiform sensitive organ which winds round supports to enable weak stems to reach the light. Tendrils are of various morphological origin in different groups. Some may be modified branches, others leaves, another the end of a leaf rachis, etc.

TEPAL, a division of a perianth; a word applicable to either a sepal or a petal. "An anagram of *petal*," Jackson.

TERETE, cylindrical.

TERNARY, with 3 members in a whorl.

TERNATE, in groups of 3. A leaf with 3 leaflets is sometimes said to be ternate, but in this case it is really the *leaflets* which are ternate and the leaf is 3-foliolate.

TESTA, the outer covering of a seed.

TETRADYNAMOUS, with 4 long and 2 short stamens.

THORN, a modified shoot or branch in the form of a hard spine.

THORN WOODLAND, forests composed principally of thorny species.

THYRSE, a close panicle more or less spindle-shaped.

TOMENTOSE, with exceedingly close matted short pubescence.

TORULOSE, alternately swollen and constricted.

TORUS, the portion of the floral axis from which spring the perianth, stamens, carpels or any portion of the flower. The torus may therefore be convex, cylindrical, concave, etc. Same as receptacle in some senses.

TRICHOTOMOUS, with the axis successively dividing into three branches.

TRICOCCOUS, ultimately splitting into 3 cocci.

TRI-PINNATE, with the primary axis of the leaf pinnate with one or more pairs of the pinnæ again pinnate and with one or more pairs of the secondary pinnæ pinnate.

TRIPLE-NERVED, 3-nerved, with 3 nerves from base; with 3 primary nerves.

TRIQUETROUS, with 3 sharp corners.

TROPOPHILOUS. Plants adapted for a physiologically wet climate at one season of the year and a dry climate at another season are termed tropophilous.

TRUNCATE, as though cut off at the end.

TUBER, a short, thick, more or less succulent rootstock or rhizome, *e. g.* potato; or the swollen end of a root which is attached at the upper end to a rootstock or rhizome as in *Curcuma*, etc.

TURBINATE, top-shaped.

TURGID, tense as though with pressure from within; swollen.

UMBEL, an inflorescence in which the branches all radiate from the top of the peduncle. If these branches each terminate in a flower the umbel is *simple*; if they are again umbellately branched, the umbel is *compound*.

UNILOCULAR, applied to an ovary not divided up by partitions into separate compartments.

URCEOLATE, flask-shaped and broadest below the middle.

VALVATE, said of sepals, etc., when they are only connate in bud by their edges, which do not overlap.

VENTRAL, the lower side. This is the popular usage, but it is the side towards the axis of the inflorescence in the case of flowers, and towards the axis of the flower or ovary in the case of carpels, towards the ventral suture of the carpel in the case of ovules. (*N.B.*—I may sometimes have inadvertently used it in the popular sense. The term "axial-side" would be less ambiguous.) *Cp.* Anterior, Posterior.

VENTRICOSE, suddenly bulged.

VENULOSE, with numerous vein-like raised lines; closely finely veined.

VERNATION, the method in which leaves are arranged or folded in bud.

VERRUCOSE, covered with wart-like small bosses.

VERSATILE, said of an anther which is attached above its base to the attenuated tip of the filament on which it swings.

VERTICILLATE, whorled.

VILLOSE, villous, covered with long fine soft hairs.

VIRGATE, with slender erect rod-like stems or branches.

VISCID, with a sticky secretion.

XEROPHILOUS, adapted by structure to conditions of drought.

XEROPHYTES, plants which inhabit localities where they are subject to conditions of physiological drought.

ZYGOMORPHIC, symmetrical right and left of the median plane only, as in many lipped flowers. Sometimes equivalent to *irregular*.

TABLE OF CORRESPONDING ENGLISH AND METRIC LENGTHS.

Approximate Equivalents of Fractions and Decimals of an Inch, Lines and Millimetres.

Inches		Lines.	Mm.
1/32	·031		·79
1/30	·033		·8
1/25	·04		1
1/24	·042	½	1·06
1/20	·05		1·3
1/16	·06		1·6
1/15	·07		1·7
	·079		2
1/12	·08	1	2·1
3/32	·09		2·4
1/10	·1		2·5
1/9	·11		2·8
	·118		3
1/8	·12		3·2
	·125	1½	
1/7	·14		3·5
	·157		4
5/32	·16		4·1
1/6	·17	2	4·2
3/16	·19		4·8
	·196		5
1/5	·2		5·1
	·21	2½	
7/32	·22		5·5
	·236		6
¼	·25	3	6·3
	·275		7
9/32	·28		7·1
	·3		7·6
5/16	·31		7·9
	·314		8
⅓	·33	4	8·5
11/32	·34		8·7
	·354		9
⅜	·37		9·5
	·39		10
	·4		10·1
13/32	·406		10·3
	·417	5	10·6
	·432		11
7/16	·44		11·1
15/32	·47		11·9
	·472		12
½	·5	6	12·7
	·511		13
17/32	·53		13·5
	·55		14
9/16	·56		14·3
	·58	7	
	·589		15
19/32	·59		15·1
	·6		15·2
⅝	·62		15·9
	·629		16
21/32	·66		16·7
⅔	·667	8	16·9
	·668		17
11/16	·68		17·5
	·7		17·78
	·707		18
23/32	·72		18·2
	·747		19
¾	·75	9	19·05
25/32	·78		19·8
	·786		20
	·8		20·3
13/16	·81		20·6
	·825		21
	·83	10	
27/32	·84		21·4
	·865		22
⅞	·87		22·2
	·9		22·8
	·904		23
29/32	·91	11	23·1
15/16	·94		23·8
	·943		24
31/32	·97		24·6
	·982		25
	1	12	25·3995
	1·17		30
	1·56		40
	1·96		50
	2		50·79
	2·35		60
	2·75		70
	3		76·2
	3·14		80
	3·53		90
	3·94		100
	4		101·6
	5		127·0
	6		152·4
	7		177·8
	8		203·2
	9		228·6
	10		254·0
	11		279·4
	12		304·8

ADDENDA AND CORRIGENDA.

P. 6. Under *R. scleratus* for *Scelery* read *Celery*.

P. 49. For *T. obcordate* read *T. obcordata*.

P. 59. For *Mahanedi* read *Mahanadi*.

P. 62. For *U. lobota* read *U. lobata*.

P. 64. In Key to *Hibiscus* for *bracteoles* 4–5 in case of *H. pungens* read *bracteoles* 4–7.

P. 93. Under *G. elastica*, sub-sp. *vestita*, Wallich's type, for *brown, villous* read *brown-villous*.

P. 160. *Zanthoxylum acanthopodium*. The Chainpur Hills alluded to are in Nepal and *this species should be deleted*.

P. 306. Under *Ceratonia siliqua* for *Locus* read *Locust*.

P. 325. *Acacia pseudeburnea*. Parker considers this to be *A. Campbellii*, Arn.

P. 340. *Potentilla supina*. Add to localities S.P. near Sahibganj, *Kurz*! Fl. May. Banks of Sone, *Anderson*.

P. 343. Family *Droseraceæ*. *The cauline leaves are whorled in Aldrovanda*.

P. 347. *R. candelaria*. In the third line of the small type under this species for *R. conjugata* read *R. mucronata*.

P. 404. Family *Umbelliferæ*. In penultimate line of description, for *radical* read *radicle*.

P. 417. *Cornaceæ*. The dots in the leaf are not glandular but due to cystolith cells.

P. 460. For 3. *B. divergens* read 3. *V. divergens*.

P. 577. *Ehretia microphylla*, Lamk. appears to be the earliest name for *E. buxifolia*, Roxb. and should be substituted.

P. 590. For *I. bona-nox* read *C. bona-nox*.

P. 630. In the last line but two of note, for *Illysanthes* read *Ilysanthes*.

P. 659. *Spathodea campanulata*. The following further field notes have been found: Bark sometimes white, smooth. Leaves about 19″ with 11–15 leaflets with the 7–8 prs. of nerves prominent as seen from the ground (against the sky). Lflts. oblong opposite shining 2–4″ long. Fls. 4–5″ by 3–4″ with spathaceous reflexed brownish calyx 2·5″ long. Fls. March. Deciduous Feb.

P. 678. Mr. Gamble after again carefully comparing the specimen when revising the genus *Strobilanthes* for the *Flora of Madras* considers that this is *S. Heyneanus*, Nees, which agrees with my original identification.

P. 681. *Phaylopsis* being a *nomen conservandum* should be retained in place of *Micranthus*.

P. **741**. To the genus *Elsholtzia* should be added *E. blanda*, see below.

P. **755**. In *Nyctaginaceæ*, for *stamens* 9–30 read *stamens* 1–30.

P. **798**. The specific name of our species *C. filiformis*, L. has been omitted under the genus *Cassytha*.

P. **805**. In the last line of the account of *S. album* for *Santal* read *Sandal*.

P. **826**. To the genus *Ficus* should be added *F. palmata* and *F. carica*, see p. 187.

P. **882**. In middle of page, for *Cycus* read *Cycas*.

P. **890**. To the genus *Cyperus* should be added *C. digitatus*, see p. 188.

P. **898**. Last paragraph, for *Syn. eleusinoides* read *Syn. Cyperus eleusinoides*.

P. **905**. Mr. Turrill had already previously made the *new combination* for *Pycreus pumilus* in *Kew Bulletin*, 1922, p. 123; the authority should therefore be *Turrill*. The combination *P. globosus* has already been made by Reichenbach in the *Flora Germanica Excursoria* (Addenda, p. 140), and the authority should be *Reichb.*

P. **1072**. In description of *Xyridaceæ*, for *ovules anatropous* read *ovules orthotropous*.

P. **1073**. In description of *Flagellariaceæ*, for *sub-petioled* in fifth line read *sub-petaloid*.

P. **1074**. In description of *Commelinaceæ*, for *stamens in 2-3-merous whorls* read *stamens in* 2 3-*merous whorls*.

P. **1074**. In description of *Commelina* add *petals equal or 2 larger or differently coloured from the third*.

P. **1183** *et seq*. In the description of ferns, for *venules* read *veinlets* wherever it occurs.

P. **1251**. For *Elytophorus* read *Elytrophorus*.

The descriptions of the following species have been accidentally omitted :—

13. ELSHOLTZIA, *Willd.* (p. 741).

2. **E. blanda,** *Benth.* Syn. Aphanochilus blandus, *Benth.*

A slightly aromatic herb 2–4 ft. high with lanceolate leaves 1·5–3″ long acuminate both ends, base attenuate into a very short petiole, nearly glabrous beneath with conspicuous glands, puberulous above, margin coarsely serrate. Flowers very small, white, in slender unilateral panicled spikes, terminal spikes 3–4″ long, bracts acicular. Fruiting calyx ·1″ long, the subulate teeth exceeding the tube or not. Nutlets yellow ellipsoid-oblong compressed, ·02–·03″ long, attached by a minute mucronate base.

Rajmahal, *Ham.*! Probably in the hills. Fl. Oct. Fr. Nov. A native of the mountains of Sikkim, Assam, Khasia and Burma.

A stouter plant than *E. incisa* and easily distinguished by the lanceolate leaves and shorter petioles and secund flowers. Petiole up to ·5–·6″ long. Cor. ·11″ long, with numerous yellow glands and curled white hairs, minutely hairy and with a ring of long hairs within. Fruiting spikes up to .3″ diam.

8. FICUS, *L.* Fig.

In Key on p. **828** for last 6 lines substitute :

b. Erect cultivated shrubs or small trees. Recepts m.s. to large, solitary or paired, axillary :—
Sub-arboreous L. pale or hoary, usually tomentose beneath, mostly not lobed. Recepts 1″ or less, mostly stalked . . . . . 22*a. palmata.*
Shrubby. L. deep green, rarely tomentose beneath, mostly deeply lobed. Recepts 1·5″, mostly subsessile . . . . . . 22*b. Carica.*
c. Recepts very large on tubercles or special short branches. (The rest as before.)

22*a.* **F. palmata,** *Forsk.* Syn. F. caricoides, *Roxb.* Angjir, *Vern.*

A small tree with usually well-developed main stem, young branches pubescent or tomentose, glabrescent. Leaves 5–10″ long, rather membranous broadly ovate, cordate, mostly simple, rarely lobed two-thirds down, crenate- or dentate-serrate or coarsely serrate, pale, scabrous or hairy above, hairy to villosely tomentose beneath, base with 3 strong and 1–2 weaker nerves, sec. n. 3–6 on mid-rib. Petiole 1–2″ long. Recepts peduncled, sub-globose to pyriform, umbonate, ·5–1″ diam., tomentose or pubescent, yellowish when ripe.

Occasionally cultivated in Northern Area. Bettiah, *Hieronymus* ! Patna and Gya, *Ham.* ! Shahabad, *Ham.*
Probably a cultivated variety of *F. carica* and often scarcely distinguishable.

22*b.* **F. Carica,** *L.* Angjir, *Vern* ; The Fig Tree ; Caprifig (the male uncultivated form).

A spreading much branched small tree or shrub, branchlets slightly pubescent or hispid. Leaves coriaceous, nearly all angular, lobed or deeply palmate and segments again sometimes lobed, above deep green somewhat scabrid or hispid, beneath downy or sometimes tomentose or sometimes only scabrid, margin repand dentate. Female recepts more or less pyriform, peduncles very short, male recepts apple-shaped or spheroidal on longer peduncles attaining 1·3″. The cultivated fig often, however, appears androgynous.

Rarely cultivated in our area. Patna, *Ham.* !
This is the well-known European fig which De Candolle considers may have been indigenous over the middle and southern part of the Mediterranean basin. *Aitchinson* ("Botany of the Afghan Delimitation Commission," *Trans. Linn. Soc.*, Second Series, iii, p. 109) says that it appears to be indigenous also in the Badghis country and East Persia where he found it in clefts of rocks and escarpments of hill-sides. The leaves in these wild plants are very variable and *F. palmata* is probably only a cultivated descendant. The male fl. in both has about 6 lanceolate segments, gall fl. similar or segments nearly free or free and linear lanceolate as in the female flower.

1. CYPERUS, *L.*

Add to Key on p. **892**, b, ii.

† Gls. ovate. Spkts. ovate or oblong or if linear ·1″ broad . . . . . spp. 26–28.
†† Gls. linear ovate. Spkts. linear . . 28*a. digitatus.*

28*a*. **C. digitatus,** *Roxb.*

A tall robust handsome sedge 1·5–4·5 ft. high with stout rhizome. Stem 3-gonous and up to ·2″ diam. at the top. Leaves often as long as the stem ·5–·7″ broad. Umbel very compound and 6–20″ diam. with the bracts usually far exceeding the umbel and ·3–·5″ broad. Spkts. ·35–·75″ long by ·05″ broad in cylindric corymbose spikes 1–3″ long with an angled or winged rhachis. Gls. ·12″ long, linear with scarious sides and slightly apiculate. Wings on rhachilla narrowly linear, deciduous. St. usually 1 often persistent until the wings fall. Nut grey ·05–·06″ long, 3-quetrous, very concave towards rhachilla.

Sarjuga, *C. B. Clarke*! Bhagalpur, *Ham.*! Fl. Aug.–Nov.

Whole plant glabrous. Easily distinguishable from *C. exaltatus* by the long, much narrower linear spikelets. It is, I believe, a fairly common sedge not often collected.

INDEX TO PART I.

Names of genera and species merely occurring in lists without special remark are not indexed here. Vernacular names additional to those occurring in the body of the work are indexed.

Abnus, 25
Acacia arabica, 4, 12
„ Campbelli, 185
„ Donaldi, 16
Acanthaceæ, 133, 140, 142
Achimenes family, 141
Achras dissecta, 73
Acrid juice, 117
Actiniopteris, 8
Adhatoda, 34
Ægle, 95
Agave family, 152
Aghani, 34
Ailanthus, 95
Aizoaceæ, 93, 101, 102
Alangiaceæ (Cornaceæ), 122, 185
Alangioideæ (-ales), 92, 96, 121
Albizzia, 16
Algonkian beds, 11
Alismaceæ, 83, 85, 146
Alluvium, 4, 18
Amarantaceæ, 101, 103
Amaranth family, 103
Amarkantak, 9, 22
Amaryllidaceæ, 151, 152
Amentiferæ, 81, 82, 83, 125
Ammannia, 36, 96
Ampelidaceæ, *see* Vitaceæ
Amsaheri, 75
Amtiya, 75
Anacardiaceæ, 95, 114, 117
Aneilema, 33
Angiosperms, 80, 89, 90
Angul, 14
Anona, 97, 98
Anonaceæ, 97, 98
Antidesma, 111
Apetalæ, 81, 92
Apocynaceæ, 132, 136, 137
Aponogeton, 146
Aquatic formation, 35
Araceæ (-ales), 83, 85, 146, 147
Araliaceæ, 121
Archæan Rocks (*see also* Gneiss), 13
Archegonia (archegoniatæ), 77,89
Area (division of), 1, 3
Argemone, 93
Argyreia, 139
Arhar, 34
Arisæma, 147
Aristida, 16
Aristolochiaceæ (-ales), 92, 93, 100
Arnatto, 108
Aroid family, 147
Aroids, aquatic, 36
Arthil, 71
Artocarpus, 34, 81
Asan (Terminalia), 8
Asclepiadaceæ, 132, 136, 137
Asterales, 133, 144
Atalanta, 16
Athgarh sandstone, 16, 17
Aura, 72
Averrhoa, 95, 114
Avicennia, 143
Azima, 92

Bael, 34
Bagandi, 72

Bagnai, 71
Bahar, Behar, Bihar, vi
Baincha, 71
Balanophora, 95
Balanophoraceæ, 122, 123
Balasore, 18
Balsam family, 115
Balsaminaceæ, 94, 114, 115
Bamboos, 16, 34, 46
Banakangro, 74
Banana family, 154
Ban mirchi, 71
Bar, 75
Barberry family, 99
Barley, 34
Barringtonia, 35
Basalt, *see* Trap
Batatas, 139
Baul, 73
Bauxite, 17
Beet family, 103
Begoniaceæ, 92, 107, 110
Begonia family, 110
Bennettiteæ, 82
Berberidaceæ, 97, 99
Bes, 72
Bhado, Bhadoi, 34
Bhagalpur, 35
Bhant, 72
Bignoniaceæ, 140, 141
Bija, 16
Biophytum, 95
Birna, 35
Bischofia, 111
Bixaceæ, 93, 106, 108
Bombaceæ, 110
Bonai, 14
Boraginaceæ (-ales), 133, 139
Borassus, tapping of, 72
Boropahar forest range, 15
Bougainvillea, 102
Brassica, 107
Breynia, 8
,, rhamnoides, 34
Bridelia, 16
Bromeliaceæ, 151, 153
Bruguiera, 49
Buddleia, 136
Bulbous herbs, 33, 38
Burha, 73
Burhi lat, 72
Burmah, species common to, 20
Burmanniaceæ, 151, 153
Burseraceæ, 114, 116
Butea frondosa, 4, 12
Buttercup family, 97

Cactaceæ, 100
Cactus, 70, 100
Cæsalpiniaceæ, 96, 127
Callitrichaceæ, 111, 112
Calyciforæ, 91
Calycinæ, 150
Campanales, 133, 144
Campanulaceæ, 133, 144
Cannabinaceæ, 112, 113
Cannabis, 112
Cannaceæ, 154
Cansjera, 92, 95
Capparidaceæ, 92, 93, 106, 107
Caprifoliaceæ, 80, 133
Carboniferous shales, 12
Carex, 149
Careya, 33
Caricaceæ, 92, 107, 109
Carissa, 12
Carnation family, 102
Caryophyllaceæ, 101, 102
Caryophyllales, 93, 101
Casearia family, 108
Cassytha, 99
,, filiformis, 186
Castor Oil family, 112
Casuarinaceæ (-ales), 82, 83, 94, 131, 132
Celastraceæ, 119
Celastrales, 95, 118
Ceratophyllaceæ, 97, 99
Chagalnadi, 75
Chandka forest, 16
Characeæ, 36
Chasmophytes, 40
Chaurs, 5
Chenopodiaceæ (-ales), 101, 103
Chigas, 71
Chittagong element, 20, 44, 46, 48
Choripetalæ, 92

Chromite, 15
Chrysopogon aciculatus, 4
Chulmuli, 75
Churs, 5
Cissampelos, 92, 98
Cistineæ, 106, 108
Citrus, 95, 114
Clays, 12
Cleistanthus, 16
Clematis, 92, 97, 98
Cloud, 26
Club mosses, *see* Lycopodiales
Coalfields, 7, 12, 17
Coffee family, 143
Coldenia, 139
Colvillea, 71
Combretaceæ, 96, 128, 129
Commelinaceæ, 149, 150, 186
Compositæ, 144
Conglomerates, 16
Coniferæ, 90
Convolvulaceæ, 132, 133, 138
Conyza ambigua, 44
Corchorus, 110
Cordaiteæ, 78
Cordia, 132, 139
Cordiaceæ, 139
Cornaceæ, 122
Coronarieæ, 151
Cotton soil, 9, 14, 18
Crassulaceæ, 92, 125, 126
Crinum, 33
Crops, 34
Croton and Castor Oil family, 112
Cruciferæ, 93, 106, 107
Cryptocoryne, 34, 147
Cucurbitaceæ, 92, 93, 107, 110
Cunoniales, 125
Curculigo, 152
Curvembryeæ, 101
Cuscuta, 139
Custard Apple, 34, 98
Cuttack, 17
Cyatheaceæ, 80, 88
Cycadaceæ, 90
Cycadeoides, 82, 84
Cycadophyta, 82, 89
Cyclanthaceæ, 146, 148
Cyperaceæ, 148, 149
Cyperus, 187
,, digitatus, 188
Cystoliths, 142
Damuda fossils and rocks, 5, 7, 8, 12, 17
Dantranga, 73
Darbhanga, 4
Datura, 140
Denudation of Central Tract, 9
,, of Hazaribagh, 3, 70
,, of Monghyr, 3
,, of Rajmahal, 8
,, of Shahabad, 6
Dha, 73
Dhaman, 74
Dhamin, 71
Dhanuja, 73
Dhao, 71, 73
Dharwars, 6, 10, 14, 15
Dhaula, 71
Dhela, 75
Dhenkenal, 14, 17
Dhuna, 74
Diaras, 5
Dichondra, 138, 139
Dicotyledons, 81, 90, 91
Dillenia, 98
Dilleniaceæ, 97, 98, 104
Dioscoreaceæ, 151, 153
Diospyros, 8
Diplachne, 4
Dipterocarpaceæ, 104, 105
Disciforæ, 91
Distribution of some species, 44, 46, 47, 48
Dock, 104
Dodonæa, 117
Dog-banes, 71
Doka, 75
Dome gneiss, 5, 11
Dracæna, 152
Drift seeds, 50
Droseraceæ, 96, 125, 126, 185
Dubrajpur sandstone, 8
Dudhi, 72
Dudh Koraiya, 72
Dudh latta, 72
Dumar, 75
Dungruki, 73
Duranta, 143

Dwarf shrubs, 33
Dykes, 12, 15, 16

Ebenaceæ, 132, 134, 135
Enantioblasteæ, 149
Endlicher's system, 84
Endosperm, 89
Engler's system, 82
Epigynæ, 151
Equisetales (Horsetails), 78, 80, 86
Eriobotrya, 96
Eriocaulaceæ, 149, 150
Eriolæna, 8
Erythrina, 33
Escallonia, 125
Euphorbia (fleshy), 14
Euphorbiaceæ, 93, 94, 111, 112
Euphorbiales, 92, 94, 111
European genera, 34
Evergreen forest, 42, 48
Evodia meliæfolia, 46

Ferns, 79, 80, 87
Feronia, 95
Ferruginous sandstones, 17
Ficus, 11, 40
,, Carica, 186, 187
,, palmata, 186, 187
Fig-marigold, 101
Fig and Mulberry family, 113
Figs, 112, 113
Filicineæ (-ales), 80, 87
Flacourtia, 34
Flacourtiaceæ, 92, 93, 106
Flacourtineæ, 106, 108
Flagellariaceæ, 149, 150, 186
Flame tree, 70
Flax family, 115
Flueggia, 111
Fluviales, 145
Forest destruction (*see also* Denudation), 42
Forest, percentage of, 3
Formations, botanical, 33
Formations, geological, 18
Fragaria, 34
Frankincense tree, 70, 74
Frost, 28, 35
Frost-hardy species, 28, 42
Fumariaceæ, 92, 93, 106, 108
Fumitory family, 108

Gab, 73
Gadha Bar, 75
Gaira, 71
Galgal, 74
Gamboge, 105
Gamopetalæ, 80, 91, 92, 132
Gandhai, 74
Gangetic Plain, 2, 4, 5, 33
,, ,, Flora of, 33
Gangpur, 14
Gardenia, 14, 40
Gaya, 3, 5, 6
Gentianaceæ (-ales), 133, 136, 137
Geological changes, 11
Geraniaceæ, 94, 95, 114, 115
Geraniales, 95, 114
Geranium family, 115
Gesneraceæ, 140, 141
Ghatera, 73
Ghats, 9
,, eastern, 13
Ghorkund, 71
Ghunt, 71
Gidaur Hills, 6, 10
Gidha, 74
Ginger family, 154
Gira, 74
Giridih coal-field, 7, 12
Gleicheniaceæ, 80, 88
Gloriosa, 152
Glossopteris flora, 7, 78
Glumifloræ, 148
Gneiss, 9, 10, 12, 14, 17
Gnetaceæ, 81, 82, 90
Gnetum, 81
Gondwana land, 7, 78
,, province, 2
,, rocks, 6, 7, 8, 11, 12, 16, 17
Gourd family, 110
Gramineæ, 148, 149
Granite, 11, 14, 17
Grass family, 149
Grass lands, 38, 43

Grazing, 39
" damage, 8, 11, 39
Grevillea, 95
Grewia, 33, 110
Gruinales, 114
Gugal, 71
Guhiya Babul, 71
Gular, 75
Guruj, 71
Guttiferaceæ (-ales), 92, 93, 104, 105
Gymnosperms, 78, 80, 81, 89
Gynandræ, 155

Hæmadoraceæ, 151, 152
Hæmatite, 14, 15, 16
Halorrhagidaceæ, 128, 130
Hamamelidales, 125
Har chikkar, 72
Hardwickia, 6, 42
Harhar, 73
Haril, 75
Harila, 72
Hathibari forest range, 14, 17
Hazaribagh, 6
" flora, 70
Helobiæ, 145
Hemp and Hop family, 113
Hendesal forest, 16
Henna family, 129
Herbaceous perennials, 38
Hernandiaceæ, 92, 97, 99
Heteropanax, 8
Hewittia, 139
Hibiscus, 110, 185
Hijal family, 129
" *see* Barringtonia
Himalayan element, 44, 46, 48
Hippocrataceæ, 95, 119
Hiran, 74
Hollarhena, 8
Holly family, 119
Hop family, 113
Hornwort, 99
Horse-radish tree family, 109
Horsetails, *see* Equisetales
Human factor, 42
Humidity, 25
Hutchinson's classification, 84
Hyal (Barringtonia), 73
Hydrangea, 125
Hydrocaryaceæ, 130
Hydrocharitaceæ, 146
Hydrophyllaceæ, 138
Hydropterideæ, 88
Hypericaceæ, 104, 105
Hypoxis, 33
Hyptis, 12

Icacinaceæ, 95, 119, 120
Ice plant, 102
Ikri, 35
Ilex, 95
Ilicaceæ, 92, 95, 119
Impatiens, 95, 114
Indian cinchona, 71
Indigo, 34
Induced scrub (scrub due to human agency), 3, 6, 9, 30, 35, 42, 47, 63
Iridaceæ, 151, 153

Ja, 73
Jack, 34
Jasminum, 132, 136
Jharia coalfield, 7, 12
Jhungjuni, 72, 74
Jiyal, 75
Juglandaceæ, 82
Jugya, 74
Jujube family, 120
Juncaceæ, 150, 151
Jungle fires, 39
Jussiæa, 36
Jute, 34
Jute family, 111

Kadapahs, 11, 15, 16
Kadrupala, 75
Kahu, 72
Kaimur Hills, 6
Kalahandi, 14
Kangra, 35
Kanker, 4, 12, 18
Karam, 73
Karas, 8

Karaundas, 71
Karaunji, 71
Karzanis, 70
Kasambar, 75
Kasi, 35
Kaskas, 35
Kat kareza, 71
Katra, 35
Kend, 71, 73
Keonjhur, 14
Kesari (Scirpus), 35
Khair, 42
Khair-sissu forest, 37
Khaj, 72
Khajur, 72
Khandobola Mt., 14
Khangta, 73
Kharagpur Hills, 4, 6
Khirni, 73
Khoksa, 72
Khondalite, 14
Khongtu, 73
Khota pipar, 75
Khurda, 17
Kirganelia, 111
Koraiya, 72
Koya, 35
Kshir, 75
Kungchla, 73
Kunker, 4, 12, 18

Labiatæ (-ales), 133, 142, 143
Lat or latta signifies any climber
Laterite, 8, 12, 14, 17, 18
Lauraceæ, 97, 99
Laurel family, 99
Lavandula, 143
Lawia (Terniola), 46
Lawsonia, 96
Lecythidaceæ, 128, 129
Leea, 95, 120
Leguminosæ, 96, 127
Lemnaceæ, 146, 147
Lentibulariaceæ, 140, 142
Liliaceæ, 81, 151
Liliifloræ, 151
Limestone, 5, 10, 11, 15
Limnanthemum, 36
Linaceæ, 94, 114, 115
Linociera, 135, 136
Lippia geminata, 35
Littoral species, 48
Lobelia zeylanica, 44
Locust tree, 185
Loganiaceæ, 136, 137
Loranthaceæ, 123
Loranthus, 46, 92, 95
Lotus, 36
Ludwigia, 96
Lycopodiales, 80, 86
Lythraceæ, 96, 128, 129

Madlat, 71
Madmala, 71
Magnolia, 98
Magnoliaceæ, 81, 83, 97, 98
Mahadeva beds, 17
Mahul, 73
Mahuya, 73
Maize, 34
Makarkand or Makr Kend, 71, 73
Maleswari, 73
Mallow family, 111
Malpighiaceæ, 94, 114, 117
Mals of Orissa, 47
Malvaceæ, 92, 93, 110, 111
Malvales, 92, 93, 94, 110
Mamroja, 75
Man, 71
Mandar, 75
Manganese, 15
Mangifera, 114, 116
Mangjari, 75
Mango family, 116
Mangrove, 48
,, family, 130
Marantaceæ, 154, 155
Marattiales, 80, 87
Markhoa, 71
Marsh flora, 35, 36
Marsiliaceæ, 87, 88
Martynia, 140
Marua (Eleusine), 34
Mahuya (Bassia), 73
Matisura, 75
Mayurbhanj, 14
Meghasani, 21
Melastomaceæ, 96, 128, 129

Meliaceæ, 92, 95, 114, 116
Memecyleæ, 129
Memecylon, 75
Menispermaceæ, 97, 98
Mesembryanthemum, 102
Mica, 11
Micranthus, 185
Milky juice, plants with, 40
Millets, 34
Mimosaceæ, 92, 96, 127
Mimusops, 34
„ elengi, 73
Mistletoe family, 123
Mixed forest, 42, 46
Mogul, 71
Mohwa (Bassia), 8
Mohwa family, 135
Monghyr, 3, 5, 6, 10
Monghyr flora, 70
Monochlamydeæ, 92
Monocotyledons, 81, 83, 91, 145
Moraceæ, 94, 112, 114
Morawa, 73
Moringa, 92, 93
Moringaceæ, 92, 93, 109
Moringineæ, 107, 109
Mucuna spp., 51
Mulberry, 34
„ family, 113
Munggar, v
Murga, 75
Musa, 154
Musaceæ, 153, 154
Muzaffarpur, 4
Myrabolan family, 131
Myriophyllum, 96, 130
Myrrh family, 116
Myrsinaceæ, 92, 132, 133, 134
Myrtaceæ, 128, 129
Myrtales, 97, 128

Naga Untari Hills, 11
Naiadaceæ, 146
Namta, 75
Naravelia, 98
Narsingpur, 16
Natsiatum, 95
Nemophila, 138
Nepaul lilac, 71
Neterhat, 17, 22
Nettle family, 113
Neuri, 73
Nicandra, 140
Nigella, 97, 98
Nilgiri gneiss, 10, 14
Nilkar, 74
Nyctaginaceæ, 92, 93, 101, 102, 186
Nyctanthes, 8, 135
Nymphæaceæ, 97, 99

Oats, 34
Ochna, 33
Ochnaceæ, 95, 105, 114, 115
Olacaceæ, 95, 122
Olacales, 96, 122
Olax, 92, 95
Oldenlandia, 15
Oleaceæ, 92, 132, 133, 135, 136
Oleales, 132, 133, 135
Olibanum, 74
Onagraceæ, 128, 130
Ophioglossaceæ, 80, 87
Opilia, 95
Opuntiales, 92, 93, 100
Orange family, 116
Orchidaceæ, 155
Orissa province, vii, 2
Orobanchaceæ, 140, 141
Oroxylum, 140
Osmundaceæ, 80
Oxalidaceæ, 114

Pakar, 75
Palæopitys Milleri, 78
Palamau, 6
Palasi, 75
Palmaceæ (-ales), 146, 148
Palm family, 148
Pancratium, 33
Pandanaceæ (-ales), 146, 147
Pangdan, 75
Papaveraceæ, 106, 107
Papaya family, 109
Papilionaceæ, 127, 128
Parar, 72
Paras, 75

Parasnath, 9, 10, 21
Parasnath flora, 45
Parietales, 93, 96, 104, 106
Parkeriaceæ, 88
Parmi, 75
Passifloraceæ, 92, 107, 110
Passiflorineæ, 107, 109
Passion-flower family, 109
Patna, 5
Patna State, 14
Páts, 9, 12, 28, 43, 44
Paysar, 75
Pedaliaceæ, 140, 142
Peganum, 95
Pegmatite, 11
Peliosanthes, 152
Pentacyclicæ, 132
Pepper, 104
Personales, 133, 140
Phalsa, 74
Phanerogamia, 89
Pharbitis, 139
Pharhar, 75
Phaseolus, 34
Phaylopsis, 185
Phlox family, 138
Phœnix, 15
,, sylvestris, tapping, 72
Phulka, 74
Phyletic drift, 77
Phyllantheæ, 93
Phyllite, 14
Phytolaccaceæ, 93, 101, 102
Pindalu, 73
Pindar, 73
Pineapple family, 153
Piperaceæ, 82, 83, 103, 104
Pistia, 36, 147
Pitangjira, 75
Pittosporaceæ, 106, 109
Pittosporum, 92
Plant communities, 50
Plumbaginaceæ, 132, 133
Plumbago, 132
Pneumatophores, 49
Podestemonaceæ, 96, 124, 125, 127
,, (Lawia), 46
Polemoniaceæ, 133, 138
Polemoniales, 133, 137
Pollen grains, 89
Polygalaceæ, 117, 118
Polygonaceæ, 103, 104
Polygonales, 92, 93, 103
Polypodiaceæ, 80, 87, 88
Pomegranate family, 129
Pontederiaceæ, 151, 152
Popro, 73
Portulaca, 93
Portulacaceæ, 101, 102
Potamogeton, 36
Potentilla supina, 34, 185
Pothos, 147
Primo-filices, 78
Primulaceæ, 133, 134
Primulales, 132, 133
Proteaceæ (-ales), 94, 95, 96, 124
Prunus, 125
Psilophyton, 79
Psilotales, 80
Pteridophyta, 78, 79, 80, 85
Pteridosperms, 78
Punicaceæ, 128, 129, 130
Purneah, 5, 38
,, flora, 34
Purslane, 102
Putal, 74
Puter, 72
Putranjiva, 34
Pycreus globosus, *Reichb.*, 186
,, pumilus, *Turrill.*, 186
Pygeum, 125
Pyrus, 96

Quamoclit, 139
Quartz, Quartzites, 14

Rabi, 34
Rainfall, 19
Rainy days, 23
Rairakhol, 17
Rajgir Hills, 5, 10
Rajmahal Hills, 4, 6, 7, 8
Rampur forest, 16
Ranales, 83, 84, 93, 97
Randia malabarica, 4
Raniganj coalfield, 7

Ranunculaceæ, 97, 98
Reed, 5, 35
Refining sugar, plants used for, 36
Reh, 4
Rendle's classification, 85
Rhabdia, 139
Rhœadineæ, 106, 107
Rhamnaceæ, 95, 120
Rhamnales, 95, 120
Rhizomatous herbs, 33
Rhizophoraceæ, 128, 130
Rhizophora mucronata, 185
Rhyniaceæ, 79
Rice, 34
Rice-field flora, 36
Ritha, 71
Rock ferns, 47
Rosaceæ, 125, 126
Rosa involucrata, 35
Rosales, 96, 124, 125
Rose-apple, 34
„ family, 125
Roxburghiaceæ, 151, 152
Rubiaceæ (-ales), 133, 143, 144
Rutaceæ (-ales), 92, 95, 114, 116

Sabai, 8
Sabai grass, 43
Sabiaceæ, 117, 118
Saccharum spp., 35
Sagittaria, 36
Saheri, 75
Sahora, 72
Sakuya = Sal (Shorea robusta)
Sal, 5, 6, 8, 12, 14, 16, 17, 33, 39, 40, 45, 71, 74
Sal associates, 41
Sale, 74
Salhar, 74
Salicaceæ, 131
Salicales, 94, 131
Salpiglossidæ, 140
Salvadoraceæ, 92, 135, 136
Salvinia, 36
Salviniaceæ, 87, 88
Sambalpur, 14, 15
Sambalpur forest range, 17, 18
Sameshwar Hills, 1, 4, 37
Sandstone, 6, 8, 10, 12, 15, 16, 17
Sanseviera, 152
Santalaceæ, 95, 123
Santalales, 94, 96, 122
Santal Parganas, 5
Sapindaceæ, 95, 117, 118
Sapindales, 95, 117
Sapium, 34, 111
Sapotaceæ, 132, 134, 135
Saraikhela, 14
Saran, 5
Satinwood, 16
Saxifragaceæ, 92, 125, 126
Saxifragineæ, 125
Schists, 14, 15
Schizeaceæ, 80, 98
Scitamineæ, 153
Screw Pine family, 147
Screw-pod, 70
Scrophulariaceæ, 140, 141
Scrub, 3, 6, 9, 30, 35, 42, 47, 63
Scutia, 120
Seasons, 20
Sedge family, 149
Seeds on Orissa coast, 50
Selaginellaceæ, 86
Serpentine, 15
Sesamum, 142
Shade grasses, 43
Shahabad, 3, 5, 6
Shale, 14, 15, 16
Shorea (*see also* Sal), 93, 105
Sidda, 75
Siki, 35
Sikkat, 72
Simarubaceæ, 114, 116
Simlipahar Mts., 21
Singbhum, 14
Siphonodon, 20, 95, 119
Sissu, 4, 34
Sitti, 72
Siwalik system, 4
Slates, 10, 11
Smilax, 152
Soap-nut family, 118
Solanaceæ, 133, 138, 140
Sondar, 74

Sonerilla, 96
Sophora, 128
Spadicifloræ, 146
Spathodea campanulata, 185
Spear grass, 43
Species in each family, 66
Spectre tree, 70
Spermophyta, 80, 89
Spinach, 103
Spiræa, 70
Spondias, 117
Sporobolus, 4
Staphylleaceæ, 117, 118
Stephania, 98
Sterculia, 93, 110
Sterculiaceæ, 94, 110, 111
Streblus asper, 34
Strobilanthes Heyneanus, 185
Strychnine family, 137
Strychnos, 16, 73
Stunted forest, causes of, 2, 3 (*see also* Scrub)
Stylidiaceæ, 144
Styraceæ, 92, 134
Sunderbans species, 49
Sundew family, 126
Swamps, 35
Swietenieæ, 114
Sympetalæ, 132
Symphorema, 132, 133, 143
Symplocos, 92
Synangium, 88

Taccaceæ, 151, 152
Tal, 72
Talchir beds, 17
Talchir-Kaharbari beds, 7
Tamaricaceæ, 92, 104, 109
Tamariscineæ, 107, 109
Tamarisk (Tamarix), 5, 35, 92
Tanai bangs, 72
Tar, 72
Tarsi, 75
Tasar, 72
Tea, 105
Teak, 16, 20, 45
Teak family, 143
Temperature, 26, 27
Terminalia, 42, 71, 72
Ternstrœmiaceæ, 104, 105
Tetracyclicæ, 132
Tetrameles, 125
Thalamifloræ, 91
Thalictrum, 98
Thanki, 74
Theaceæ, 104, 105
Theales, 93, 104
Thin bark, 40
Thorny species, 47
Thunbergia, 132
Tilai, 73, 75
Tiliaceæ, 94, 110, 111
Toddalia, 114
Toddy, 72
Trachyte, 8
Tragia, 111
Trap, 5, 7, 8, 15
Trapa, 96, 128, 130
Trewia, 111
Tropæolaceæ, 114
Tundi Hills, 9, 10
Tupidanthus, 121
Turneraceæ, 106, 108
Typha, 35
Typhaceæ, 146, 148

Ulmaceæ, 112
Umbellales, 95, 121
Umbelliferæ, 121
Urticaceæ, 93, 112, 113
Urticales, 93, 94, 112
Usar, 4
Utricularia, 37, 70, 141

Vahlia, 96, 125
Vapour, 25
Verbenaceæ, 132, 133, 143
Veronica, 34
Vertebraria, 7
Vetiviera, 35
Vindhyan range, 6
Vine family, 120
Violaceæ, 93, 106, 108
Vitex, 143
Vitaceæ, 95, 120
Vivipary, 49
Volcanic rocks, *see* Trap

Walsura, 16
Waltheria, 94, 110
Water Hyacinth, 152
Water Lilies, 35, 36, 99
Wendlandia, 8
Wheat, 34
Wild rose, 5, 55
Williamsonieæ, 82
Willow family, 131
Woodfordia, 92

Xanthium, 132
Xerophytes, 40, 49
Xylia, 16
Xyridaceæ, 149, 150, 186

Yam family, 153

Zingiberaceæ, 154
Zizyphus, 12
Zygophyllaceæ, 95, 114, 115

ADLARD AND SON AND WEST NEWMAN, LTD., LONDON AND DORKING.



Reg: No. 712 F 19-750

Published at the request of the Conservator of Forests, Bihar and Orissa
1919

HELIOZINCOGRAPHED AT THE SURVEY OF INDIA OFFICES, DEHRA DUN

THE

BOTANY OF BIHAR AND ORISSA

An Account of all the Known Indigenous Plants of the Province and of the Most Important or Most Commonly Cultivated Exotic Ones

With Map and Introduction

By

H. H. HAINES, C.I.E., F.C.H., F.L.S.
Late Conservator of Forests, Bihar and Orissa

Published under the Authority of the Government of Bihar and Orissa

PART II

LONDON
PRINTED BY ADLARD & SON & WEST NEWMAN, LTD.
And Sold by the Agents for Indian Official Publications
1921

Price Ten Rupees

Agents for the Sale of Books Published by the Bihar and Orissa Government.

Agents in India.

(1) Messrs. Thacker, Spink & Co., Calcutta.

(2) Messrs. W. Newman & Co., Calcutta.

(3) Messrs. K. S. Lahiri & Co., College Street, Calcutta.

(4) Messrs. R. Cambray & Co.,6 and 8–2, Hastings St., Calcutta.

(5) Messrs. Thompson & Co., Madras.

(6) Messrs. D. B. Taraporevala, Sons & Co., 103, Meadow Street Fort, Post Box No. 18, Bombay.

(7) Messrs. M. C. Sircar & Sons, 75, Harrison Road, Calcutta.

(8) Proprietor of the Newal Kishore Press, Lucknow.

(9) Messrs. M. N. Burman & Co., Bankipore.

(10) Babu Ram Dayal Argarwala, 184, Katra Road, Allahabad.

(11) Standard Literature Co., Ltd., 13–1, Old Court House St., Calcutta.

(12) Manager of the Indian School Supply Depôt, 309, Bow Bazar Street, Calcutta.

(13) Messrs. Butterworth & Co., Ltd., 6, Hastings Street, Calcutta.

(14) Messrs. Ram Krishna & Sons, Anarkali Street, Lahore.

Agents in the United Kingdom.

(1) Messrs. A. Constable & Co., Ltd., 10, Orange St., Leicester Square, London, W.C. 2.

(2) Messrs. Kegan, Paul, Trench, Trübner & Co., 68–74, Carter Lane, London, E.C.4 (Oriental Department), and 39, New Oxford Street, W.C. 1.

(3) Mr. B. Quaritch, 11, Grafton Street, New Bond Street, London, W. 1.

(4) Messrs. P. S. King & Son, 2 and 4, Great Smith Street, Westminster, London, S.W. 1.

(5) Mr. B. Blackwell, 50, 51, Broad Street, Oxford.

(6) Messrs. Deighton Bell & Co., Ltd., Trinity St., Cambridge.

(7) Messrs. Henry S. King & Co., 65, Cornhill, London, E.C. 3.

(8) Messrs. Grindlay & Co., 54, Parliament Street, London, S.W. 1.

(9) Messrs. W. Thacker & Co., 2, Creed Lane, Ludgate Hill, London, E.C. 4.

(10) Messrs. Luzac & Co., 46, Great Russell St., London, W.C. 1.

(11) Messrs. Oliver & Boyd, Tweeddale Court, Edinburgh.

(12) Messrs. E. Ponsonby, Ltd., 116, Grafton Street, Dublin.

(13) T. Fisher Unwin, Ltd., 1, Adelphi Terrace, London, W.C. 2.

(14) Wheldon & Wesley, Ltd., 28, Essex St., London, W.C. 2.

Agents on the Continent.

(1) M. Ernest Leroux, 28, Rue Bonaparte, Paris, France.

(2) Maurtious Nijhoff, The Hague, Holland.

THE BOTANY OF BIHAR AND ORISSA

AN ACCOUNT OF ALL THE KNOWN INDIGENOUS PLANTS OF THE PROVINCE AND OF THE MOST IMPORTANT OR MOST COMMONLY CULTIVATED EXOTIC ONES

WITH MAP AND INTRODUCTION

BY

H. H. HAINES, C.I.E., F.C.H., F.L.S.

LATE CONSERVATOR OF FORESTS, BIHAR AND ORISSA

Published under the Authority of the Government of Bihar and Orissa

PART II

LONDON

PRINTED BY ADLARD & SON & WEST NEWMAN, LTD.

And Sold by the Agents for Indian Official Publications

(*For list see previous page*)

1921

Price Ten Rupees

THE BOTANY OF BIHAR AND ORISSA.

PART II.

NOTE.—Part I, not yet issued, will contain the Introduction and General Remarks on the Botany of the Province.

The order of the Families is that of the 'Flora of British India,' except that the Samydaceæ have been included with the Flacourtiaceæ, the Aizoaceæ have been placed next to the Portulacaceæ, and the Euphorbiaceæ have been introduced between the Malvales and the Geraniales. With the last exception the artificial group of the Apetalæ is being retained to facilitate reference with Herbaria, the 'Flora of British India,' and other Provincial Floras. The approximate positions of the apetalous families among their petalous allies will be indicated as far as possible in the Introduction.

Part II contains families to the end of Thalamifloræ as detailed below:—

1. RANUNCULACEÆ.
2. DILLENIACEÆ.
3. MAGNOLIACEÆ.
4. ANONACEÆ.
5. MENISPERMACEÆ.
6. BERBERIDACEÆ.
7. NYMPHÆACEÆ.
8. PAPAVERACEÆ.
9. FUMARIACEÆ.
10. CRUCIFERÆ.
11. CAPPARIDACEÆ.
12. VIOLACEÆ.
13. BIXACEÆ.
14. FLACOURTIACEÆ (WITH SAMYDACEÆ).
15. PITTOSPORACEÆ.
16. POLYGALACEÆ.
17. CARYOPHYLLACEÆ.
18. PORTULACACEÆ.
19. AIZOACEÆ.
20. ELATINACEÆ.
21. TAMARICACEÆ.
22. HYPERICACEÆ.
23. GUTTIFERACEÆ.
24. TERNSTRŒMIACEÆ.
25. DIPTEROCARPACEÆ.

26. MALVACEÆ.
27. STERCULIACEÆ.
28. TILIACEÆ.
29. EUPHORBIACEÆ.
30. CALLITRICHACEÆ.
31. LINACEÆ.
32. MALPIGHIACEÆ.
33. ZYGOPHYLLACEÆ.
34. GERANIACEÆ.
35. BALSAMINACEÆ.
36. RUTACEÆ.
37. SIMARUBACEÆ.
38. OCHNACEÆ.
39. BURSERACEÆ.
40. MELIACEÆ.
41. ICACINACEÆ.
42. OLACACEÆ.
43. ILACACEÆ.
44. CELASTRACEÆ.
45. HIPPOCRATACEÆ.
46. RHAMNACEÆ.
47. AMPELIDACEÆ.
48. STAPHYLEACEÆ.
49. SAPINDACEÆ.
50. SABIACEÆ.
51. ANACARDIACEÆ.

Where no synonyms are given the name is used in the same sense as in the 'Flora of British India.' Adherence to the International Rules has caused, unfortunately, several departures from the names used in that monumental work, and doubtless there are cases where changes should have been made in conformity with those rules, but have escaped attention. In a few cases, however, well-known names have been retained in spite of those Rules. Several names have become familiar, not only to botanists, but to all Indian residents who take an interest in silviculture or gardening, and I have thought it preferable to retain these, provided, of course, that they are not incorrect, while adding the new name as a synonym.

FAM. 1. RANUNCULACEÆ.

Herbs or shrubs with alternate or (Tribe Clematideæ) opposite, usually exstipulate often compound leaves with sheathing petioles. Flowers regular or irregular. Sepals often petaloid. Petals hypogynous, variable, sometimes 0 or reduced or modified into nectaries. Stamens many, hypogynous, anthers usually adnate and dehiscing laterally. Ovary apocarpous (very rarely syncarpous, *e. g. Nigella*), carpels usually many, often spirally arranged on an elongate torus, 1-celled with 1 or more anatropous ovules on the ventral suture, ovules erect or pendulous. Fruit a head of achenes or follicles (connate in *Nigella*). Seed albuminous, embryo minute.

I. (Clematideæ) climbing shrubs. L. opposite, sepals petaloid.
  Petals 0. L. with terminal leaflet (rarely simple) . . . 1. *Clematis.*
  Petals linear. L. with terminal tendril . . . . . . 2. *Naravelia.*
II. Herbs. L. radical or alternate.
  A. Sepals petaloid. Petals 0, or nectarial. Carpels few.
    Fls. very small panicled. Carpels 1-ovuled . . . 3. *Thalictrum.*
    Fls. m.s. solitary. Carpels many-ovuled . . . . 4. *Nigella.*
  B. Sepals sepaloid. Petals usually 5. Carpels many . . 5. *Ranunculus.*

1. CLEMATIS, *L.*

Shrubs, usually climbing by means of their twisted petioles. Leaves opposite, usually pinnately compound and ending in a terminal leaflet. Stamens many. Carpels many, distinct in fruit, and ending in a long feathery persistent style or naked beak. Ovule 1, pendulous.

A. L. compound. Filaments hairy.
  L. not tomentose. Fls. white or cream . . . . . . 1. *nutans.*
  L. tomentose beneath. Fls. yellow tomentose . . . . 2. *Wightiana.*
B. L. compound. Filaments glabrous. Fls. white . . . . 3. *gouriana.*
C. L. simple. Fls. purple . . . . 4. *smilacifolia.*

1. **C. nutans,** *Royle.* Bonga ghanti, *S.*

A climbing shrub with angled silky pubescent branchlets and 1-2-pinnate leaves with coarsely toothed simple or lobed leaflets and large cream-coloured flowers on axillary leafy branchlets, long peduncled.

Champaran (Sameshwar Hills)! Singbhum, on Hæmatite rocks, above 2000 ft.! Manbhum, 3000 ft. *Grieve*! Hazaribagh (Baragaon) *Wood*! Ranchi (Kerhang, 2500 ft.) *Gamble*! Fls., Fr. Nov.-Jan.

Larger leaflets, 2·5–5″, ovate with cordate base, smaller ovate-lanceolate, acuminate, shortly hairy. Buds oblong acute, over 1″, beautifully silky. Sepals suberect, 1–1·5″, with curled tips. Filaments villous.

Var. **patens** (*F. C. N.*).

Buds ovoid, under 1″. Sepals spreading, 1″ by ·5″, 5-7-nerved. Sundi Buru, Porahat!

2. **C. Wightiana,** *Wall.*

This is easily distinguishable by the pinnate leaves being yellowish-tomentose beneath. Leaflets usually 5-lobed and serrate. Flowers yellow brown-tomentose outside.

Flowers February–March.

It is recorded from the hills of Orissa in the *F.B.I.*, but there are no specimens from Orissa in *Herb. Cal.*, nor have I seen any from Bihar and Orissa. It is chiefly a South Indian plant.

3. **C. gouriana,** *Roxb.* (etym. from its covering the ruins of Gour in Maldah). Golarang, *Uran.*

A climbing shrub with adpressed-hairy grooved branches and 2-pinnate leaves with entire or coarsely-toothed ovate-acuminate leaflets. Flowers white and cream, scented, ·5–·75″ diam., in copious axillary and terminal 3-chotomous panicles.

Rather rare. Singbhum (Kundrugutu ravine)! Parasnath! Palamau (Aday, 1500 ft.)! Fls. Oct.–Nov., Fr. Dec.–Jan.

Somewhat resembles the English "Traveller's Joy" (*C. vitalba*). Leaflets 1–3·5″ ovate or ovate-lanceolate with cordate base, thinly hairy, with delicate raised nerves, petioles articulate with hairs at the joint. Sepals ·3″, spreading or ultimately revolute, 4-, rarely 5, ciliate.

Said to abound in an acrid poisonous principle (*Watt*).

4. **C. smilacifolia,** *Wall.*

A tall tough climber with very long, often coiled petioles, by which it climbs; shining, rather fleshy cordate-ovate simple leaves, 3–7″ long, with 7–9 basal nerves and panicles of brownish flowers 1–1·5″ diam., with 4–5 coriaceous sepals.

Angul, 1500 ft. (*Lace*)! Mayurbhanj, over 3000 ft. near water! Fls. Oct.–Feb., Fr. May.

Branches grooved. L. with 7–9 basal nerves, glabrous, entire or remotely serrate. Petioles united at base. Sepals tomentose, purple within. Achenes elliptic, ·2″, flat, very hairy, with thick margins and long feathery styles 1·5–2″ long, hairs often golden.

This is a species of damp evergreen forests. Some specimens from Sikkim are 3-foliolate with more acuminate leaflets, but this form has not been found in Bihar and Orissa.

2. NARAVELIA, *DC.*

Differs from Clematis in the leaf rachis ending in a tendril and in the 6–12 linear petals.

1. **N. zeylanica,** *DC.* Chagal-bate, *Beng.*

A climbing shrub with pubescent or tomentose branches, simply pinnate leaves with a single pair of leaflets, and the end of the rachis converted into a branched tendril. Flowers yellowish green or whitish, ·5–·75″ diameter, in axillary and terminal panicles. Petals spreading, equal to or shorter than the tomentose sepals.

Champaran! Purneah! Along ravines and nalas in Singhbhum, common in Samta range! Base of Parsnath (*And.*). Fls. Sept., Fr. Dec.–Feb.

Leaflets 2, broadly- or orbicular-ovate, 5–6″ by 2·5–3″, sub-tomentosely villous beneath, usually with a short cusp or acumination, sub-palmately nerved, toothed. Panicles 3–10″. Achenes villous, with hairy styles 2″ in fruit.

The roots are tuberous. Ropes are made from the stems.

3. THALICTRUM, *L.*

Erect herbs with compound, often ternately decompound, leaves with sheathing petioles. Stipules often present as auricles or nearly free. Flowers small, racemed or panicled. Sepals 4–5, petaloid. Petals 0. Stamens ∞. Carpels few or many. Ovule 1-pendulous. Fruit a small head of achenes.

1. **T. foliolosum,** *DC.*

A very graceful fern-like erect herb 3-4 ft. high with 3-pinnate leaves, the ultimate pinnæ with usually ternate roundish lobulate leaflets ·25–·7″, rarely 1·5″ diameter. Flowers small, green, white or purplish, on capillary pedicels in ample terminal panicles. Stamens exserted on filiform white or pink filaments. Carpels 4- (-5-) ridged.

The higher hills of Chota Nagpur, 2500-4000 ft. Ichadag (Ranchi)! Neterhat (Palamau)! Sirguja, *Clarke*! Parasnath (Hazaribagh)!

Distribution: Temp. Himalaya, Khasia Hills, Upper Burmah, Dehra-Dun (U.P.), Ganjam (?).* Fls. June-Aug., Fr. July-Sept. Perennial.

Stipules not distinct from the leaf sheath. Leaflets pale, glaucous beneath, venose. Pedicels ·3–·6″. Petals ·1″, linear-oblong, minutely gibbous at base, caducous. Anthers yellow linear. Achenes ·12″, turbinate, 8-ridged.

2. **T. javanicum,** *Blume.*

A similar but less robust herb, easily distinguished by the better developed stipules, the club-shaped filaments, numerous carpels, and also, less generally, by the more ternately divided leaves and thicker, more venose leaflets.

Parasnath (Hazaribagh), *J. D. Hooker.*

4. NIGELLA, *L.*

Erect annuals with pinnately dissected leaves. Flowers moderate sized, terminal, white blue or yellowish, sometimes with an involucre of laciniate bracts. Sepals 5, imbricate, petaloid. Petals 5, transformed into nectaries, 2-fid, clawed. Carpels 3–10, connate, except sometimes at the extreme top. Ovules 2-seriate. Fruit sub-capsular, the follicles being only free above, splitting through the inner top and finally sometimes also through the style and down the back.

1. **N. sativa,** *L.* Syn. N. indica, *Roxb.* Mugrela, Kalajira, *Vern.*

A pretty herb 1-2 ft. high, with 2-3-pinnatisect leaves 1-2″ long cut into linear or linear-lanceolate segments, and solitary long-peduncled pale blue flowers ·8-1″ diam. with ovate, acute, clawed sepals. Nectarial petals 8, geniculate, with a saccate gland in the knee, one on the face and one on the apex of each lobe. Carpels (3-) 5, styles ·3-·4″ long, persistent, capsule ·5″ long.

Fls., Fr. Feb.-April. Sometimes cultivated and an occasional weed of cultivation in the Gangetic plain! Seeds pungent, aromatic and stimulant; used by the natives in their curries.

5. RANUNCULUS, *L.*

Herbs with simple, lobed or dissected leaves with sheathing petioles. Flowers small to large, often panicled. Sepals 3–5, sepaloid, imbricate. Petals usually 5, rarely 0, with often a gland near the base. Carpels ∝, styles very short. Ovule 1, ascending. Fruit of beaked or apiculate achenes.

1. **R. pensylvanicus,** *L.*

An erect buttercup with fibrous roots, erect hairy stems, 1–2 ft. high, and yellow flowers ·7–·8″ diameter. Heads of achenes large, up to ·4″ long, globose-ovoid. Achenes smooth and glabrous, not pitted, ·12″ long, distinctly margined.

* Specimens named *T. javanicum* in the *Cal. Herb.* collected by Gamble from Palamau and Mahendragiri (Ganjam) not in flower nor fruit appear to be *T. foliolosum.*

Along streams in the higher hills of Palamau, especially abundant at Koorgee below Neterhat, elevation about 3000 ft.! Fls. May–July, Fr. June–Aug.

Distribution: Upper Burma (Maymyo), Assam and Khasia Hills, Nepal, Oudh, also China and N. America.

Stems sulcate, branched. Radical and lower stem leaves 3-foliolate with 3-sect leaflets and petioles, 2–4″; uppermost sessile on a short sheath, ternatisect. Leaflets 1–1·5″, hairy beneath and less so above, lobed and coarsely serrate. Peduncles corymbose, erect, stout. Receptacle oblong, hairy. Sepals at first spreading, then reflexed and membranous, oblong, ·2″, hairy. Petals ·3–·35″, oblong, rounded, with an orbicular scale at base.

Differs from the usual type of *R. pensylvanicus* in the broader oblong leaf-segments.

2. **R. sceleratus,** *L.* Scelery-leaved Crowfoot.

An erect, glabrous annual, 1–2, rarely 3 ft. high, much branched, with usually 3-partite leaves, the segments cuneate and again lobed. Flowers small, ·25–·3″ diameter, numerous, terminating the branchlets and from the forks. Achenes many, rather turgid, not margined, glabrous on an oblong hairy receptacle.

In the northern tract, in wet places chiefly on the west. Champaran! Fl., Fr. c.s. to March.

Stems fistular. Lower L. petioled, 3-sect, upper sessile, uppermost often simple linear lanceolate. Sepals spreading and reflexed, somewhat pubescent outside. Petals scarcely exceeding the sepals.

The plant is very acrid. It is a common European plant near the sides of ponds and streams.

FAM. 2. DILLENIACEÆ.

Trees or shrubs with simple alternate, often large and strongly-nerved entire or toothed exstipulate leaves with sheathing base to the petiole. Flowers usually large, yellow or white. Sepals 5, rarely more, imbricate persistent. Petals 5, rarely fewer. Stamens many, hypogynous, sometimes connate below; anthers innate, dehiscing laterally or by terminal pores. Carpels 1 to many, whorled, free, or cohering in the axis with free styles. Ovules 1 to many, amphitropous, placentation various but raphe ventral. Fruit follicular, capsular or baccate. Seeds arillate, albumen fleshy, embryo minute next the hilum.

1. DILLENIA, *L.*

Trees with large leaves and very strong pinnate venation. Flowers solitary or fascicled. Stamens nearly free, filaments not thickened upwards, anthers linear, inner introrse, outer recurved extrorse. Carpels 5–20, cohering in the axis, styles stigmatose, ovules indefinite. Fruit composed of the enlarged fleshy imbricate sepals enclosing the ripe indehiscent carpels.

Fls. large white. Fr. 4″ diam. . . . . 1. *indica.*
Fls. large yellow, 3-4″ diam. Fr. 2″ diam. . . . . . 2. *aurea.*
Fls. moderate sized, yellow, 1-1·5″ diam., clustered. Fr. ·75″ . . 3. *pentagyna.*

1. **D. indica,** *L.* Korkotta, *K., S.*; Chalta, Hargeza, *Beng.*; Oao, *Or.*

A rather small but beautiful tree with a dense crown; deep green leaves 8–10″ by 2–4″ and white solitary flowers 5–6″ diameter.

Very frequently planted, but probably only wild in northern Purneah. In its undoubtedly wild state (as in the Duars) it is found along muddy streams. Wild in Hindol, Kalahandi and Bonai, *teste Cooper*. It does not thrive in dry districts. Fls. May–June. Fr. Sept.–Feb. Evergreen.

L. lanceolate, pubescent beneath, with 30-40* close parallel secondary nerves, each running into a strong tooth. Petiole 1–2″. Carpels 20.

The large fleshy accrescent calyces which form the outer covering of the fruit are eaten before they are quite ripe, usually after cooking. The wood is not much used. Hamilton, who mentioned it as scarce in Purneah, says that it is used by the joiners.

2. **D. aurea,** *Sm.* Korkotta, *K.*, *S.*; Aghai, *Th.*; Keringila, Karmata, *Gond.*; Rai, *Or.*

A small, crooked tree with obovate broadly oblong or elliptic leaves 12–20″ by 4·5–7″ with a distinct petiole 1–3″ long. It bears large solitary beautiful yellow flowers terminating the leafless branches (when it has been repeatedly mistaken for Cochlospermum, though the habit and trunk are quite different.)

Throughout the province, from Bettiah! to Sambalpur! and Puri! in hilly districts. Very common in places on clay-schists, trachyte or grit. Ascends to 3000 ft. at Neterhat! Fls. April–May. Fr. May–June. L. drop at end of Jan. and are renewed end of May.

Attains 3-4 ft. girth, with nearly smooth light-coloured bark. Blaze dark crimson, usually with a light crimson border inside and outside the darker belt. In leaf it is often confounded with *D. pentagyna*, from which it is distinguishable by both habit and habitat. The L. are usually smaller, when young beautifully silky above, tomentose beneath between the 25–50 close strong secondary nerves, spinulose-denticulate; adult pubescent or somewhat hairy beneath, with margin sub-entire except for the excurrent nerves. Peduncles lateral but close to the terminal bud, stout pubescent, 1–3″ long, with 3-4 recurved bracts. Sepals ·75–1″. Petals obovate-lanceolate, 3″ by 2″. Styles 10, ·5″, spreading and recurved. Ovules many, 2-seriate in each carpel.

Wood reddish brown, only used as fuel; makes a good charcoal. Fruit edible and is greedily eaten by wild elephants, which destroy the trees to obtain them.

This is probably the tree called "Dengr" by Hamilton in his account of Purneah: "A fine species of *Dillenia* with a large fine yellow flower. Fruit about size of a large apple and used as an acid in seasoning." But I have never seen the fruit the size of a *large* apple, but rather a *small* one.

3. **D. pentagyna,** *Roxb.* Rai, *K.*; Sahar, *S.*; Aghai, *Th.*; Agor (*Monghyr*).

A moderate-sized often straight tree with elliptic or narrowly elliptic leaves 12–36″ long, decurrent and amplexicaul, scarcely petioled. Flowers very numerous in umbels along the leafless branches.

Along the northern boundary, especially in Purneah! In the central and southern tracts confined to the valleys, especially at the higher elevations, and not very common, though occurring in all districts! Angul, common! Fls., March–April. Fr. May. Deciduous end of Feb. to May.

Attains 4–5 ft. girth. Blaze light crimson, or streaked light crimson and white. L. much as in last but adult nearly or quite glabrous between nerves beneath, margin repand crenate and together with the excurrent nerves forming teeth; base much more tapering than in *D. aurea*, most often forming a wing on the petiole, which hence appears absent or is under 1″ long. Peduncles slender, 1–2″, ebracteate. Carpels 5.

"The wood is reddish grey and durable but liable to warp and split" (*Gamble*). It gives an excellent charcoal. The fruit is eaten. The tree is sensitive to frost but is difficult to kill by girdling.

---

* The number of secondary nerves always refers to the number each side the words "each side" being understood.

FAM. 3. MAGNOLIACEÆ.

Trees or shrubs with simple alternate entire leaves, usually with convolute stipules sheathing the bud and leaving a circular scar (resembling some Urticaceæ and Moraceæ) on falling. Flowers axillary and terminal, often showy, white, yellow or red, sometimes unisexual. Sepals and petals often subsimilar, arranged in trimerous whorls, free, hypogynous, soon falling. Stamens ∞, free or monadelphous; anthers basifixed, cells adnate. Ovary apocarpous, carpals often on an elongate axis, sometimes partly cohering and in one whorl (*Illicium*); styles stigmatose on the inner surface. Ovules 2 or more on the ventral suture, anatropous or amphitropous. Fruiting carpels baccate, follicular or dry. Seeds 1 or few, testa single or double, albumen present, sometimes oily. Embryo minute, cotyledons spreading, radicle next the hilum.

Talauma (from the Himalayas) is occasionally cultivated in our area, as also are species of Magnolia. Oil of anise is obtained by distillation of the fruits of the Star Anise (*Illicium verum*)—an American species.

Carpels on a stalked gynophore. Ovules 2-12 . . . . . . 1. *Michelia.*
Carpels on a sessile gynophore. Ovules 2.
  Carpels dehiscent persistent . . . . *Magnolia.*
  Carpels indehiscent, deciduous . . . . *Talauma.*

1. MICHELIA, *L.*

Trees, sometimes flowering as shrubs. Stipules convolute, leaving a circular scar. Flowers solitary, white or yellow. Perianth leaves in 3 or more 3-merous series. Filaments flat with introrse anthers. Carpels spiral on an elongate axis which is on a gynophore, coriaceous and dorsally dehiscent in fruit.

1. M. champaca, *L.* Champa, Champaka, *H., Or.*

A large tree 60-80 ft. high and 6-7 ft. girth with rusty tomentose shoots, oblong-lanceolate or ovate-lanceolate long-acuminate leaves attaining 12″ by 4″, and sweet-scented yellow flowers 2″ diam. Fruiting spike of sub-sessile carpels 3-4″ long.

A rare and beautiful tree inhabiting deep valleys cooled by springs in the Saranda forests (especially Tholokabad and Karampoda) in Singbhum! Palamau, Neterhat, 3000 ft., rare! Common in Mayurbhanj above 2500 ft. in the valleys! Bonai (*Cooper*)! "Many very fine trees up to 10·5 ft. girth in the Korari valley (Bonai)" (*Cooper*). Khuldia, Nilgiri State. *Cooper*. Purneah, not very common (*Hamilton*). Often planted! Fls., April-May. Fr. July. Evergreen. New L. in April.

Bark pale grey, smooth. Blaze hard, mottled cream and orange. L. softly tomentose when young, adult rusty-hairy on the strong secondary nerves beneath, very reticulate between; secondary nerves about 15 looped within the margin. Petiole ·75-1″. Peduncle with 2 coriaceous silky caducous bracts which sheath the young flower-bud and leave an annular scar below it. Ovules 10-12, 2-seriate. Seeds scarlet.

"Wood soft, even-grained, heart-light olive-brown. Very durable. Weight 37 lb. Experiments with Ceylon wood gave co-efficient of transverse strength 3·488 tons per sq. in. Coefficient of elasticity 502·15 tons per sq. in." (*Gamble*).

This valuable tree has been neglected in the past and I have seen it removed in favour of Sal, than which it is much more valuable. It is very sensitive to frost and seedlings require protection.

FAM. 4. ANONACEÆ.

Trees or erect or climbing shrubs usually with lanceolate scaleless buds and alternate exstipulate, simple entire leaves, which are often pellucid dotted. Flowers often greenish and pendulous, sometimes bright-coloured and showy, perianth leaves in 3 (rarely 2, in *Anona*) 3-merous whorls, outermost "sepals" small. Stamens ∞ with adnate anthers, connective often produced or dilated. Carpels few or many, free (connate in *Anona*), on a rounded torus, usually stalked in fruit and resembling an umbel of distinct fruits, indehiscent, 1- or more-seeded. Seeds large with copious albumen and small embryo. The ruminate, often deeply laminate endosperm of the seeds is very characteristic of this family.

Quite small L. very frequently occur on the twigs below the normal-sized ones.

A. Stamens closely packed with broad overlapping connectives which conceal the anther cells.
  1. Tepals in two series, or those of third series very small. Carpels sub-connate; connate and fleshy in fruit . . . 1. *Anona.*
  2. Tepals in three series (or 2 in *Uvona longiflora*), inner two series petaloid, subsimilar. Carpels free.
    a. Petals with spreading limb but concave connivent bases hooded over the stamens . . . . . 2. *Artobotrys.*
    b. Petals without concave hooded bases.
      Scandent shrubs. Petals orbicular, outer imbricate . 3. *Uvaria.*
      Scandent shrubs or small trees. Petals valvate. Ovules 2–6 4. *Unona.*
      Erect trees or shrubs. Ovules 1–2 . . . . . . 5. *Polyalthia.*

B. Stamens loosely imbricate, connectives narrow, not concealing the anther cells.
  1. Outer two series of tepals small sepaloid, third series "petals" larger petaloid.
      Base of petals not saccate. Ovules 1–2 . . . . . 6. *Miliusa.*
      Base of petals saccate. Ovules 6–many . . . . . 7. *Saccopetalum.*
  2. Outermost series of tepals small sepaloid, inner two series "petals" petaloid. Ovules 4–many . . . . . 8. *Alphonsea.*

1. ANONA, *L.*

An exotic genus of which species have become naturalised in India. Leaves pellucid dotted. Petals (second series of perianth leaves) triquetrous with concave base. Carpels sub-connate, ultimately confluent into an ovoid or globose syncarpous fruit. Carpels 1-ovuled.

1. **A. squamosa,** *L.* Nenwa, Mandal, *K.*; Mandargom, *S.*; Sitaphal, *Beng.*; Saripha, *H.*; Ata, *Or.*; The Custard Apple.

A shrub or small tree with oblong or oblong-lanceolate leaves, the larger 4″ by 1·25″ to 6″ by 2″, acute, obtuse or sub-acuminate, nearly glabrous, pellucid-punctulate and slightly scented. Flowers drooping, yellowish green, ·75–1·25″ long; petals narrowly-oblong, third series of petals minute or 0. Fruit tubercled.

Completely wild now in the jungles of western Palamau, and on the scrub-hills of Hazaribagh and Manbhum. Also run wild over the northern hills of the Santal Parganas. Judging from the native names its introduction must be exceedingly ancient. Fls. March-May. Fr. July-Sept.

Cultivated largely, and is one of the fruits that thrive in Chota Nagpur. The root and L. are used medicinally and are a valuable insecticide.

2. **A. reticulata,** *L.* Gom., *S.*; Anta, Ramphal, *H.*; Barhial, *Or.* Bullock's Heart.

Leaves larger, 5–8″, acuminate glabrous. Flowers 2–3, together, innermost tepals narrow-oblong. Fruit larger, areolate, but not at all tubercled. Occasionally cultivated, very common in Purneah.

Fruit December.

2. ARTABOTRYS, *R. Br.*

Sarmentose or scandent shrubs with shining leaves. Flowers solitary or fascicled, usually on woody hooked branches. Sepals 3, valvate. Petals 6, 2-seriate, with concave connivent bases and spreading limb which is flat, sub-terete or clavate. Stamens with dorsal anther cells. Carpels few or many with oblong or columnar style and 2 erect collateral ovules. Ripe carpels baccate.

1. **A. odoratissimus,** *R. Br.* Champa, *H.*

A large sarmentose glabrous shrub with shining oblong or lanceolate leaves 2–8″ long and solitary or paired green flowers turning yellow, on hooked or circinate ultimately woody peduncles. Petals 1–1·75″ long. Ripe carpels large, green or ultimately yellow.

Fls. April–June and r.s.
Cultivated in gardens, and has a heavy Jasmine odour.

3. UVARIA, *L.*

Sarmentose shrubs, more or less stellately pubescent or scaly on the shoots. Flowers solitary, terminal or leaf-opposed, or 1–4 on abbreviated lateral branches, red (in our species). Sepals 3, valvate. Petals 6, large, orbicular or oblong, somewhat concave. Carpels many, linear oblong, when ripe ovoid or oblong, stalked, sub-baccate, more or less furrowed between the seeds.

L. soft pubescent or hairy. Buds tomentose . . . . . . 1. *Hamiltoni.*
L. glabrous and shining. Buds with scaly warts . . . . . 2. *lurida.*

1. **U. Hamiltoni,** *H. f. & T.* Selauli, *K.*; Lakankuli, *Or.*

A very large woody climber, often with circinate branchlets. Shoots rusty tomentose with elliptic or oblong-obovate, finely, but sometimes shortly, acuminate strongly-nerved leaves stellately-tomentose beneath and deep scarlet flowers 2″ diameter. Ripe carpels ·5–1″, oblong, tomentose, many-seeded, on stalks ·75–1″ long.

In damp, shady valleys and stony ravines. N. Champaran! Singbhum, frequent! Santal Parganas! Angul! Mals of Puri, common! Mayurbhanj! Monghyr, *Ham.*
Fls. May–July. Fr. sometimes persistent till Dec. Evergreen.
L. from 3″ by 1·25″ to 12″ by 5·25″ on the same twig, elliptic or mostly obovate, base somewhat cordate. Secondary nerves about 18. Peduncle 1–3″, bracteate.

2. **U. lurida,** *H. f. & T.* Gaichiria, *Or.*

A large woody climber with black bark closely marked with white lenticels. Leaves 4–9″, coriaceous, very polished above, oblong or elliptic-oblong acuminate. Flowers 1–1·5″ diameter, crimson inside, reddish brown outside, solitary, leaf-opposed on stout peduncles ·5–·8″

long, which together with the rounded pyramidal flower buds are closely covered with stout brown tomentose papillæ or tubercles.

Damp forests, Puri Division, frequent!
Fls. Jan.–May.

Young twigs verrucose, with small stellate scales, when dry with netted striæ. Buds densely stellate-tomentose. L. larger, 8″ by 2·5″, spreading, with stellate brown hairs beneath when young. Secondary nerves 12–18, *not* strong and not reaching margin. Petioles ·25″, curved. Peduncles leaf-opposed or appearing terminal. Sepals 3, ovate, brown, ·4–·5″, verrucose or submuricate. Petals concave, orbicular-obovate, scaly-tomentose outside and minutely tomentose within, united at the base. Stamens cuneate. Fr. carpels ·7–1·2″ long on stalks 1–3″ long.

Branches sometimes root in the ground and send up a new erect stem.

NOTE.—This is the plant described as *U. Hookeri*, King, *U. Narum*, var. *macrophylla*, *F.B.I.*, in Bengal plants from a solitary twig in the *Cal. Herb.*, from Baruni Hill, Orissa, without flower or fruit. I have collected it in the same locality. The strongly warted appearance of the calyx and peduncle is absent from all varieties of *U. Narum*. The Orissa *U. lurida* only differs from the N.E. Indian plant by the somewhat smaller flowers.

4. UNONA, *L.*

Small trees or sarmentose shrubs, the oblong minutely punctulate leaves with strong marginal and secondary nerves. Flowers solitary. Sepals 3. Petals 6 (or 3 only in *U. longiflora*), valvate or open in bud, more or less permanently cohering by their margins in *U. longiflora*. Stamens cuneate. Carpels numerous. Style ovoid or oblong, recurved. Ovules 2–8. Ripe carpels many, elongated and moniliform.

Spreading or sarmentose shrub. Petals 6, free . . . . . 1. *discolor*.
Erect shrub or small tree. Petals 3, cohering . . . . . 2. *longiflora*.

1. U. discolor, *Vahl.*

A large usually sarmentose shrub with finely striate slender twigs, oblong or oblong-lanceolate leaves 4–7″ long, glaucous beneath, with fine prominent secondary nerves, green or yellowish odorous flowers with petals 1·5–2·5″ long, and numerous moniliform carpels with 2–6 joints.

Damp forests of Puri Division (Khurda, Silingpara, Barberah)!
Fls. April–May. Fr. Sept.–Jan. Evergreen.

Innovations rusty hairy. L. sometimes only 2″ at base of shoot, acute or acuminate, shining above, beneath finely appressed, hairy or glabrescent. Base rounded or sub-cordate. Secondary nerves about 10–13. Petioles ·2–·4″, pubescent. Peduncles lateral, silky, slender, ·7″, woody, and 1·5″ in fruit. Sepals lanceolate, ·3″. Petals narrow, lanceolate, inner shorter. Fruiting carpels sub-tomentose; joints ·2–·25″ diameter, lowest shortly stalked.

The B. & O. specimens belong to var. *pubiflora* of the *F.B.I.*, with beautifully silky flowers.

(Roxburgh, *Fl. Ind.*, ii, 669, is referred to this species in various works, but he describes it as a pretty large tree, and says that the wood is employed for various purposes, but chiefly for rafters!)

2. U. longiflora, *Roxb.*

A small tree with large oblong leaves attaining 10·5″ by 4″, dark and shining above, whitish beneath, slightly furfuraceous on the nerves, otherwise glabrous. Flowers remarkably long and pendulous, up to 6 in., yellow outside, reddish within, on filiform peduncles.

Damp forests of Puri Division (in the Mals)! Fls. April–May.

Twigs puberulous. Buds rusty tomentose. L. shortly cuspidate, rarely acuminate,

base obtuse; secondary nerves strong, 10–13, with scalariform tertiaries. Petioles stout, somewhat corrugate, ·4–·6″. Fls. with linear-lanceolate acuminate petals, often cohering by their margins above. Ripe carpels about 10, 3–4-jointed, but all joints except lowest often falling.

The flowers are described as deep purple in a Khasian specimen.

5. POLYALTHIA, *Blume.*

Straight-growing trees, rarely shrubby (*P. suberosa*), with distichously spreading leaves. Flowers clustered, rarely solitary, often on small tubercles and extra-axillary. Sepals 3. Petals 2-seriate, flat. Carpels indefinite, succulent and 1-seeded in fruit. Ovules 1–2. Seeds usually 1.

A. Branchlets soon glabrous. Petals linear. Trees.
  Cultivated only. L. narrow, lanceolate undulate . . . . 1. *longifolia.*
  Forest tree. L. oblong . . . . 2. *simiarum.*
B. Branchlets pubescent. Petals ovate or oval. Small trees.
  Leaves caudate acuminate. Small tree . . . . . . 3. *cerasioides.*
  Leaves obtuse or rounded. Small tree or shrub . . . . 4. *suberosa.*

1. **P. longifolia,** *Benth & H. f.* Deodar, Debdar, Asok, *Vern.*

A straight tree with narrowly-lanceolate glabrous long-acuminate undulate leaves 3–8″ long, and numerous fascicled green flowers with lanceolate acuminate petals ·3–·5″ long. In luxuriant specimens the flowers are racemed on short special lateral branches or elongated tubercles, with slender pedicles attaining 1″ long.

Frequent in stations. Evergreen. Fls. and new L. March–April.

Grows best in the more humid districts, where it forms a fine avenue tree and it is often planted near temples.

Gamble says that in Madras it has been used for barrels, as it is tough and bends easily. Weight 37 lb.

2. **P. simiarum,** *Benth. & H. f.* Ojhar, Wojarh, *Or.*; Dighi Bentia, *S.*; Champa, *Bhuia.*

A very straight, tall, handsome tree with elliptic or oblong-acuminate or cuspidate nearly glabrous leaves, 4–10″ long, with 12–16 strong parallel secondary nerves. Flowers fascicled, with inner petals 1–1·2″ long, greenish. Carpels numerous, bright orange when ripe, 1·2–1·5″ long, ellipsoid, on stalks as long.

Damp forests in the Mals of Orissa! Mayurbhanj! Bonai, *Cooper*! Fls. March–April. Fr. May–June. New shoots June. (In Burma and Duars Fls. June–July.)

Bark smooth, pale with brownish and yellow blaze. Buds and young twigs tomentose. L. usually elliptic-oblong, sometimes obtuse, base rounded, young somewhat hairy on nerves beneath, minutely punctate. Secondary nerves straight and then curved just within the margin, fine but very distinct and raised beneath, with numerous cross tertiaries; marginal nerve distinct. Petiole ·2″, stout. Fls. usually from the previous year's branchlets on slender pedicels ·8–1·2″ long. Sepals short, orbicular. Petals linear, greenish-yellow to purplish (*King*), outer (in my specimen) ·8″, inner 1·1″ long.

The bark is used as a cure for scorpion stings. Its timber is not known to be used.

3. **P. cerasioides,** *Benth. & H. f.* Sande Ome, *K.*; Panjon, Rida, *S.*; Kudumi, *H.*; Potmossu, *Or.*

A small tree 20–30 ft. with spreading branches, distichous, dark-green, lanceolate or oblong-lanceolate acuminate, more or less pube-

scent leaves 5″ by 1·5″ to 8·5″ by 3″, and usually solitary lateral greenish flowers ·5″ diam. on bracteate curved pedicels. Fruit an umbel of many slender-stalked, bright red, globose-oblong fleshy carpels ·3″ long.

Frequent in Singbhum valleys! Manbhum! Along ravines in Santal Parganas! Orissa, frequent! Mayurbhanj! Bonai, *Cooper*! Sambalpur! Hazaribagh and Gaya Ghats!

Fls. April–May. Fr. May–Aug. Renews L. April, nearly evergreen.

Bark not thick, rough, grey. Blaze deep brown, then yellow, only the yellow noticeable in young trees.

Young twigs tomentose. L. sometimes elliptic or ovate when young but always acuminate, base rounded, softly pubescent beneath, when mature softly hairy on the nerves beneath and somewhat hirsute on midrib above. Secondary nerves about 10, oblique and arching forward within the margin. Petioles ·2–·25″. Peduncles from old leaf scars or axillary on the new shoots, solitary (rarely 2–3 on short tubercle), with 2–3 foliaceous deciduous bracts, woody and about 1–1·5″ in fruit. Sepals tomentosely hairy, ovate-acuminate, about ·3″, but sometimes only ·15″. Petals ovate, ·25″–·27″, somewhat pubescent, thick. Stalks of carpels ·5″–·7″. Seed brown, ovoid, ·25″.

Fruit sweet, eaten. "Wood, weight about 50 lb., said to be used in carpentry and for boat-building" (*Gamble*).

4. **P. suberosa,** *Benth. & H. f.* Bara Chali, *Beng.*; Burhi chamri, *Or.* (from the wrinkled bark); Lohania mossu, *Or.*

A small erect tree or shrub, often with a remarkably thick corky bark* on the branches, with oblong or oblong-lanceolate leaves 2–5″, usually deep glossy green above and with very faint secondary nerves. Flowers green and yellow or reddish, ·4–·5″ long on slender ·5–1″ peduncles, which are often 2–3 on extra-axillary tubercles. Ripe carpels pisiform red.

In shady forests and generally near streams. Singbhum (*Gamble*), very rare; Puri and Angul forests, common! Nilghiri! Probably in other Orissa States.

Fls. April–May (perhaps later). Fr. Sept.–Dec. New shoots March–April.

Bark brown. Blaze brown and red, hard. Buds and young twigs rusty, hirsutely tomentose. L. attaining 5·5″ by 2·2″, sometimes slightly obovate, obtuse both ends, shining both sides; young sparsely brown-hairy beneath. Petioles ·15″, pubescent. The peduncles are on a short extra-axillary branch, only distinguishable when young from a continuation of the peduncle by its colour and slightly greater thickness. Fls. densely silky. Outer petals ·25″, inner ·4″, oblong or oval. Drupels broadly ellipsoid, ·25–·3″, reddish, flesh very thin. Stalks of carpels about ·3″.

6. MILIUSA, *Leschm.*

Trees. Deciduous in the hot weather and bearing on the new shoots greenish drooping flowers on long pedicels in extra-axillary scorpioid cymes. First and second series of tepals small sepaloid, third series "petals" longer ovate, valvate, not saccate. Stamens and carpels numerous. Carpels linear-oblong with 1–2 ovules, when ripe globose or oblong.

1. **M. velutina,** *Hook. f. & Th.* Ome, *K. S.*; Siarbhuka, *Kharw.*; Domsal, Kari, *H.*; Kariota, *Tharu.*; Gandha Palas, *Or.*; Domgaru, *Khond* (Angul).

A tree sometimes 4–5 ft. girth, usually branched low, with large or very large broadly ellipsoid or ovate leaves more or less permanently

* The hypertrophy of the bark of the old branches is often given as a specific character, but this by no means always occurs. The bark is nearly *smooth* on some trees and not at all corky.

tomentose beneath, and green flowers on very long drooping pedicels in few-flowered extra-axillary scorpioid cymes. Fruiting carpels ·6–·75, ellipsoid downy on short stalks. Fruiting peduncles woody, over 1·5″, often 3–5″.

Throughout the Province in the damper forests from Champaran to Orissa and Sambalpur; common in Chota Nagpur.

Fls. with new small L. in May–June. Fr. June–July. Deciduous end of April.

Bark grey, rather cracked, moderately thick to thick. Blaze dark brown, then thick light brown or dirty brown with lighter streaks. Bark often fluted. All young parts densely, often villously fulvous tomentose. L. 5·5″ by 4″ to 10″ by 6″. Sepals lanceolate, scarcely hairy, ·15″–·20″; second series like the sepals but ·3″. Petals ovate to orbicular-ovate, ·4–·5″ (sometimes more, *F.C.N.*, only ·3″, *F.B.I.*). Carpels many and villous, ovules 2.

Timber used for yokes and axles, "is easily worked and durable" (*Gamble*), and the fruit is eaten. "Wood yellow when fresh cut, grey or greyish-brown when dry, moderately hard. Weight 40 to 50 lb. *P.* about 835" (*Gamble*).

7. SACCOPETALUM, *Benn.*

(Sometimes united with Miliusa.)

Trees, deciduous in the hot weather. Flowers axillary or in short lateral cymes. First and second series of tepals sepaloid, third series "petals" much larger, petaloid, with saccate base. Stamens and carpels numerous, connective produced, ovules 6 or more.

1. **S. tomentosum**, *H. f. & T.* Ome, Ombe, *K.*; Charra, *S.*; Kirua, *H.*; Kari, *Kharw.*; Ione, *Kheria.*; Patmosso, Gandhapalsa, *Or.*

A small or moderate sized tree with softly pubescent or tomentose shoots, and solitary dark purple flowers on slender pedicels nearly all lateral from the previous year's shoots. Leaves ovate-oblong, obtuse, or with short blunt acumen, aromatic.

Chota Nagpur throughout, but especially common in Palamau! Gaya! Sambalpur! Angul! Puri!

Fls. May–June. Fr. June–July. New leaves in May or June.

Bark brown, nearly smooth, with numerous fine cracks in young trees, fluted in old. Blaze yellowish, slightly pink or brown, or in older trees banded brown and white. Attains 4–5 ft. girth, but usually a small tree, and frequently flowering as a bush like the last, which in some respects it much resembles, and has been confused with it. The bark and blaze are very similar, but the mature leaves rarely exceed 6″, usually 2·25″ by 2″ to 6″ by 3·25″, with obtuse rounded or sometimes cordate base, pubescent beneath, puberulous, or quickly glabrescent between the nerves above. Secondary nerves 5–10, omitting short intermediate ones, looped or branching some distance from the leaf margin. Fr. an umbel of roundish, black, fleshy carpels, ·6–1″ diameter.

The wood is strong and durable, and taken for house poles.

2. **S. longiflorum**, *Hook. f.*

A tree with puberulous branchlets, ovate-oblong or oblong-lanceolate acuminate leaves about 8″ long by 3″ broad, appressed pubescent beneath, and solitary short-peduncled flowers from the axils of the fallen leaves. Petals 1·3″ long.

Only reported by Buchanan Hamilton from Purneah, and not since collected!

This tree, as I know it in British Bhotan, has lenticellate branches and large leaves up to 10″, not unlike those of the Champak. It fruits there in Aug. and Sept.

8. ALPHONSEA, *H. f. & T.*

Trees with coriaceous very shining leaves. Flowers clustered or in short cymes, clusters tomentose, leaf-opposed or on old twigs. Tepals in 3 series, outer "sepals" small valvate, second and third series "petals" larger and subequal with saccate base. Anther cells dorsal, connective apiculate. Carpels 2–10. Ovules 4–15.

Tall tree. L. oblong, up to 9″ . . . . 1. *ventricosa.*
Low tree. L. ovate or ovate-oblong, under 5″ . . . . . 2. *lutea.*

1. A. ventricosa, *H. f. & T.*

A tall straight tree (or small in Santal Parganas) with clean trunk and large oblong or oblanceolate-oblong leaves, 4·5 by 1·5″ (at base of twigs) to 9·5 by 2·75″, beautifully polished above. Flowers clustered in brown, velvety, sessile, leaf-opposed bracteate cymes. Ripe carpels very large, yellow-tomentose.

Ravines near water, Mayurbhanj (elevation 2500 ft.)! Santal Parganas, in Rajmahal Hills, rare!

Fls. Feb.–May. Fr. Aug. Evergreen. New shoots at time of flowering.

Bark smooth, grey, thin. Blaze thin, brown, then cream, hard. L. rather suddenly acuminate, base acute, obtuse or rounded. Secondary nerves 9–16, very fine, visible both sides, slightly hairy beneath, branched and looped. Petioles ·25–·3″ thick, hairy, as also is the mid-rib above. Cymes short and dense, mostly from the old wood. Pedicels ·3″, with a minute ovate bract near middle. Calyx ·17″ diameter, with 3 broadly ovate brown tomentose lobes. Petals ·37–·44″. Outer ovate-tomentose; inner white, ovate-lanceolate, sub-erect, acute, with saccate base, brown-pubescent. Filaments very short, broad, connective slightly produced. Carpels 8, tomentose-elongate, with about 15 ovules on the ventral suture. Stigma capitate. Fr. (in Eastern Bengal—I have not seen our specimens in fruit) like small tomentose yellow mangoes.

Gamble says it is used in boat-building and for native bows in Chittagong and the Andamans. The description of the flower is taken from the Santal Parganas tree, which is branched low and has a somewhat different habit, but most Santal Parganas trees are suffering from the removal of the surrounding jungle.

2. A. lutea, *H. f. & T.*

A small tree up to 3 ft. girth with spreading crown, elliptic-lanceolate to broadly ovate glabrous leaves beautifully polished both sides, small greenish or yellowish flowers in 3–4-flowered brown velvety clusters or cymes. Outer petals slightly larger than the inner, ·25″, with recurved tips. Carpels 2–3, ripe not seen (oval, about 6-seeded, *Roxb.*, 1–1·5″, with very short stalk, *F.B.I.*).

Puri Division, southern range, in semi-evergreen forest!

Fls. April–May. Evergreen.

Bark smooth, grey, streaked (with lenticels). Blaze moderately hard, cream or light brown. L. sometimes elliptic, subacute, or usually bluntly acuminate, base rounded or sub-cuneate. Secondary nerves 7–10, very fine. Petioles ·2–·3″. Clusters opposite to leaves and on old twigs. Peduncles ·3–·4″. Sepals short, rusty-tomentose. Outer petals appressed, yellow, silky outside, shortly pubescent within, somewhat saccate at base. Inner petals ·2–·25″, erect, with spreading tips, broadly ovate, saccate at base. Stamens very short, about 16, connective, slightly apiculate. Receptacle cylindric, pilose. Carpels pilose, oblong. Ovules 5–6.

NOTE.—The B. & O. plant differs somewhat from the type, the flowers being only ·3″ instead of ·6″ to ·75″ diameter, and in longer pedicels. Carpels also fewer.

FAM. 5. MENISPERMACEÆ.

Herbs or shrubs, nearly always climbing, with alternate exstipulate palmi-nerved simple leaves with generally entire margins. Flowers minute diœcious, 3–5 merous (but see *Cissampelos*) in cymes or racemes. Petals rarely 0. Stamens as many as petals, opposite to and often embraced by them, or anthers connate in a ring round the top of a column. Female: carpels 1–6, when ripe drupaceous with a very characteristic seed and endocarp, the latter being usually a curved, often thickened and tubercled tube containing the seed curved round a solid depressed centre; rarely seed subglobose. Albumen often ruminate. Cotyledons various.

A. Fls. umbelled or cymose, or if racemose then clustered in the axils of large persistent bracts. Stamens connate in a column. Carpel 1.
  Male Fls. 4-merous. Female tepals 2 . . . . 1. *Cissampelos.*
  Male sepals 6–10, petals 3–5. Female sepals and petals 3–5 . 2. *Stephania.*
B. Fls. panicled, racemed or axillary, if racemed without large bracts.
  1. Sepals 6, petals 0. Stamens connate in a column. Carpels 3. L. large. Fls. in large panicles . . . . 3. *Anamirta.*
  2. Sepals 6, petals 6. Stamens free.
    L. deeply cordate. Fls. racemose. Style scar sub-terminal . 4. *Tinospora.*
    L. not cordate, rarely sub-cordate. Style scar sub-basal. Fls. in axillary racemes or racemiform panicles, leaves glabrous 5. *Tiliacora.*
    Fls. axillary or in capitate cymes, leaves villous or pubescent . 6. *Cocculus.*

1. CISSAMPELOS, *L.*

A slender climber from a perennial root-stock. Male flowers cymose. Sepals 4, rarely 5–6. Petals connate into a peltate or 4-lobed cup. Anthers 4, connate round the truncate top of the staminal column and bursting transversely. Female flowers clustered in the axils of imbricating leafy bracts which are in racemes. Tepals 2, adnate to the bracts. Carpel 1. Stigmas 3. Drupe ovoid with style scar sub-basal. Endocarp horseshoe-shaped, compressed, margins tubercled.

1. **C. pareira,** *L.* Pitu-singh, Ranu-red, *K.*; Tejo mala, *S.*; Akanadi, *H.*, *Beng.*; Batulpati, *Tharu.*

Stems usually annual striate, leaves usually peltate, deltoid or broadly ovate, rarely orbicular-reniform, 1·75″ to 3·5″ with 5–7 principal nerves. Male flower in axillary corymbose usually panicled cymes.

Frequent throughout the area, especially in open and rocky valleys. Fls. June–Nov. Fr. Nov.–Jan.

L. obtuse or retuse, mucronate, with straight or shallow-cordate base, somewhat glaucous beneath, more or less pubescent or hairy. Petioles 1–3·25″. Male Fls. whitish, minute, in densely hairy cymes, in the axils of foliaceous bracts, on slender shoots, or 2-chotomously cymose on capillary ·75–1″-long branches of axillary panicles. Female racemes often 6″, bracts ·5–·7″ diameter. Drupe orange or scarlet, stone ·19″.

The plant has long, slender, cylindric, often branched rhizomes under ·5″ diameter. These are used in the fermentation of rice beer (Ili, *K.*) and in combination with Ruellia form the "Ili-ranu" of the Kols. "The Santals give the root in diarrhœa," *Camp.* Pelosin is derived from it. Pareira root is an allied Brazilian plant.

2. STEPHANIA, *Lour.*

Climbing undershrubs with usually peltate leaves. Flowers small, whitish, in compound cymose umbels. Male flower: Sepals 6–10, free. Petals 3–5, fleshy. Anthers 6, connate, dehiscence as in *Cissampelos*. Female flower: Sepals 3–5. Petals as in male. Stamens 0. Carpel 1 with 3–6-partite style. Drupe glabrous, endocarp horseshoe-shaped, compressed, margins tubercled.

1. **S. hernandifolia,** *Walp.* Syn. Akanadi, *H., Beng.*

A slender climber with peltate leaves and striate branches, sparsely pilose or glabrate, looking very like *Cissampelos* but easily distinguished by the inflorescence. The leaves are also less finely reticulate.

Bettiah, *Cal. Herb.*! Purneah! Fls. May–Oct. Fr. to Dec.

L. 1·5–5·5″, somewhat glaucous floccose-puberulose or sometimes sub-tomentose beneath, rarely glabrous, ovate, with rotund base, often sub-acuminate. Primary nerves about 5. Inflorescence pubescent.

The root is used in fever, diarrhœa, urinary diseases and dyspepsia according to the Hindu materia medica, but as *Cissampelos Pareira* has the same vernacular name it is possible that the two are often confused.

3. ANAMIRTA, *Colebr.*

Shrub climbing by means of twisted petioles and shoots with flowers panicled from the old wood and large shining leaves. Sepals 6 with 2 appressed bracts. Petals 0. Male flower: Anthers sessile, 2-celled, bursting transversely. Female flower with 9 staminodes and 3 carpels. Drupes on a 3-fid gynophore with sub-basal style scar. Endocarp spherical, deeply intruded from the base to the centre or further, the seed thus occupying a peripheral channel and being deeply hollowed out.

1. **Anamirta cocculus,** *W. & A.* Kalabiti Nai, *Or.*; Kakmari, *H.*

An extensive climber with stems up to 3″ girth and large shining ovate or sub-orbicular leaves 4–10″ on petioles 4–8″ long which have a twisted thickened base. Panicles drooping from the old wood, attaining 1 ft. or more with numerous long patent branches.

Puri Division, especially in damp forests (Berbera, Kuhuri, etc.)! Fls. April–May. Fr. June. Evergreen.

Bark light grey-brown, thick; wood very porous, with rings of bast and large medullary rays. Branches striate. Base of L. often sub-cordate, apex obtuse or acute. Primary nerves 3–5, strong, with few secondaries and transverse tertiaries. Fls. ·25″ diam. Drupels ·5″ diam.

Under the synonym of *Cocculus suberosus*, DC., *I. P. and D.* states that the poisonous berries constitute the *Cocculus indicus* of commerce which is the source of picrotoxin; they also contain 50 per cent. of oil. The juice of the fresh fruit is a good application to scabies and foul ulcers.

4. TINOSPORA, *Miers.*

Shrubs with twining stems and sometimes twisted petioles and cordate leaves. Flowers in axillary or terminal racemes or from the old wood. Sepals 6, outer minute, inner larger. Petals 6, equal,

smaller than the inner sepals. Male flower: Stamens 6, free, anther terminal on the thickened filament with 2 cells bursting obliquely. Female flower with 6 clavate staminodes. Carpels 3, with short style and lobed stigmas. Drupels 1–3, endocarp rugose, dorsally keeled, ventrally concave and intruded. Cotyledons foliaceous, ovate, spreading.

L. glabrous, not lobed . . . . 1. *cordifolia.*
L. tomentose, often 3-lobed . . . . 2. *malabarica.*

1. **T. cordifolia,** *Miers.* Gurach, *H.*, *Th.* Gulancha, Gunchi, *Beng.*; Gursilai, *Khond.*; Sarasati lat, *Mal P.*

A climber with succulent corky stems, glabrous cordate leaves, 2–4″ or rarely 5·5″ by 4·75″, and rather lax racemes, 2″, elongating and ultimately often longer than the leaves; racemes of green and scarlet drupels in fruit.

Puri! Angul! Santal Parganas! Champaran!
Fls. Aug.–Dec. (perhaps all the r.s.). Fr. c.s., deciduous March–May.
Branches in the forest sending down slender, pendulous, fleshy roots; terete, striate, with tubercled pale, sometimes shining or glaucous bark, which is finally loose. L. deeply cordate with large basal lobes, obtuse or more or less cuspidate; primary nerves 7–9, very reticulate between, with microscopic glistening glands beneath (not easily seen when dry). Petiole 1–3·5″. Racemes shorter or longer than the leaves.
Male Fls. clustered in the axils of small subulate bracts. Sepals: Outer very small, inner broadly elliptical, ·12–·15″, rounded, yellow. Petals 6, equal, ·08″, broadly spathulate and concave round the stamens when young. Pistillode 0. Female Fls. usually solitary, similar to male, but the sepals are green, petals flat, staminodes short, linear. Carpels 3, widely separated on the short fleshy gynophore. Drupels pisiform, 3, with sub-terminal style, juice very viscous. Stone broadly ellipsoid, with slender dorsal ridge and a ventral depression, slightly muricate.
Variety: The Khurda specimens have purple stems, rather thicker L., less reticulate, and the female racemes only 1–2·5″. The L. are also very slightly puberulous beneath.
The entire plant is used in medicine. Said to be a valuable tonic and best given in infusion. There are many native Indian preparations (*I. P. and D.*, p. 111, under *Cocculus cordifolius*).

2. **Tinospora malabarica,** *Miers.* (*inc.* T. tomentosa, *Miers*). Bara Padma gulancha, *Beng.*; Bara Sarasati lat, *Mal. P.*

A large climber with large orbicular, ovate, or somewhat obovate deeply cordate leaves 4″ to 9″ by 8″, frequently 3-angular or 3-lobed, and small yellowish-green flowers in racemes, usually from the old wood.

Rocky valleys, Santal Parganas! Rare.
Fls. Feb.–March. Fr. May–June. Deciduous Dec.–Feb.
Stems and thicker aërial roots lenticellate. Branchlets hairy. L. shortly suddenly caudate or acuminate. Primary nerves 5–7, secondaries 1–3, soon reticulate. Petioles 2·5–6″. Male flower fascicled, inner sepals 3·5 mm. by 2·5 mm., petals membranous, about 2 mm. Drupels scarlet or orange.
(The description of the flowers is from Diels, who united *T. tomentosa* with *T. malabarica*). Perhaps more common than is thought, the L. are high up and are deciduous while the stems might be taken for those of *T. cordifolia*.

5. TILIACORA, *Colebr.*

A large woody climber. Flowers in racemes or narrow panicles, "sometimes polygamous" *F.B.I.*; females subsolitary, males

clustered at the ends of the short panicle-branches. Sepals 6, 3 outer valvate, inner larger imbricate. Petals 6, minute fleshy quadrate or cuneate. Male flower: Stamens 6, anther dehiscence vertical, somewhat introrse, pistillode of 3 rudimentary carpels or 0. Female flower: Carpels 3–12, styles short, subulate. Drupels obovoid, laterally sub-compressed, with a narrowly horseshoe-shaped putamen enclosing a bony plate, the seed being in the horseshoe. Albumen ruminate.

1. **T. acuminata,** *Miers.* Syn. T. racemosa, *Colebr.*; Tiliakoru, *Beng.* Kalajati Noi, *Or.*

Santal Parganas, locally abundant in Rajmahal Hills (as at Barhait, Burio) ! Puri division, central and southern ranges, common ! Champaran !

Fls. April–June. Fr. June–Dec. Also seen in flower in Dec.

Bark striated. L. 3·5–7·5″ by 1·5–3·75″, broadly ovate to ovate-lanceolate acuminate, shining glabrous, base rounded or shortly cuneate on the petiole, rarely somewhat retuse. Primary nerves 1–5, but if only 1 then one or more secondary nerves close to base, other secondary nerves 1–2, all raised beneath and decurrent on the mid-rib, tertiaries finely reticulate. Petioles articulate at the base, ·5–1″ long. Inflorescence tomentose or pubescent. Female 1–2·5″ long, male panicle sometimes longer. Fls. yellowish, 3–4 bracteolate. Drupels red, ·5″ long.

6. COCCULUS, *DC.*

Climbing shrubs or sub-herbaceous (in one species a small tree). Flowers axillary or in short cymes or panicles, rarely shortly racemose. Sepals 6, inner larger. Petals 6, smaller than the inner sepals, with inflexed lateral auricles embracing the base of the stamens in the male, minute staminodes in the female. Anthers subglobose, cells bursting transversely. Carpels 3–6. Drupels compressed, endocarp shaped like an oblique corrugated horseshoe surrounding a central plate, style scar sub-basal.

1. **C. hirsutus,** *Diels.* Syn. C. villosus *DC.*

A slender villosely tomentose climber with deltoid to ovate-oblong obtuse mucronate leaves attaining 3″ by 2″, smaller upwards and oblong on the flowering branches. Flowers: Male in axillary short-peduncled small capitate cymes; female peduncle usually, 1–3-flowered, axillary, minute, greenish, ·1″ diam. Drupels dark purple.

Very common over bushes in the Sone valley, Palamau, and extending through Hazaribagh and the Santal Parganas ! Manbhum ! Puri ; common !

Fls. Nov.–April. Fr. March–May.

L. sometimes with large coarse teeth or with triangular obtuse or acute lobes. Petioles ·08–·5″, primary nerves usually 5.

The plant when triturated with water is said to gelatinise it.

FAM. 6. BERBERIDACEÆ.

Usually shrubs with scaly buds. Leaves simple or compound. Stipules rarely present. Flowers often globose, regular, solitary or racemose, usually yellow or white. Sepals and petals free, hypogynous, caducous, 3–, rarely 4–6-merous, in 2 or several whorls, imbricate, or the sepals valvate. Stamens 3–6, opposite the petals;

anthers erect, with adnate cells dehiscing by lids or valves, or by lateral or dorsal slits. Carpels 1–3, free, oblong, stigma dilated, or conic or oblong. Ovules anatropous, rarely orthotropous, basal, or on the ventral suture or parietal. Fruiting carpels dehiscent or baccate. Albumen copious. Embryo straight or curved.

1. BERBERIS, *L.*

Shrubs with yellow wood and simple or pinnate or mostly dimorphic leaves, those on the main branches converted into 3–5-partite spines, bearing in their axils abbreviated branchlets with simple coriaceous leaves. Flowers yellow, solitary, fascicled or racemed, with 2–3 appressed bracts. Sepals 3 + 3. Petals 3 + 3. Stamens 6, anthers dehiscing by valves. Carpel 1 with peltate stigma. Ovules, few erect, basal. Fruit baccate.

1. **B. asiatica,** *Roxb.*

A very pretty shrub with small 1–5-partite spines and coriaceous entire or spinose-toothed leaves 1–3″. Flowers ·25–·3″ in short corymbose racemes. Berry purple-blue, pruinose, ·3″.

Parasnath, 4000 ft. Fls. Feb.–April. Fr. May–June. Evergreen. Berries sometimes eaten. They are laxative.

FAM. 7. NYMPHÆACEÆ.

Aquatics with often peltate leaves, the margins involute in bud. Flowers solitary from the root, sepals and petals 3–5-merous, or many and often spirally arranged, sometimes adnate to a fleshy disc or enlarged torus. Stamens ∞. Ovary apocarpous or syncarpous, carpels whorled, in *Nelumbium* sunk in the enlarged torus, stigmas peltate or decurrent. Ovules parietal, anatropous or orthotropous. Fruiting carpels usually dry, but indehiscent, sometimes connate into a fleshy or spongy syncarp. The fruit sometimes matures beneath the water. Seeds sometimes arilled. Albumen flowery or 0. Embryo enclosed in the enlarged embryo sac.

A. Carpels whorled, more or less connate into a syncarpous ovary. Leaves all floating.
- Ovary somewhat sunk in the torus, to which the upper tepals only are adnate. Unarmed . . . . 1. *Nymphæa.*
- Ovary wholly sunk in the torus inferior to the tepals and stamens. Prickly . . . . 2. *Euryale.*

B. Carpels completely apocarpous, irregularly sunk in the torus. Tepals all inferior . . . . 3. *Nelumbium.*

1. NYMPHÆA, *L.* Water-lily.

Herbs with floating leaves rising from a perennial rhizome or corm. Flowers large, white, blue or red. Sepals 4, inserted almost at the base of the torus. Petals numerous, the inner gradually passing into stamens, spiral, the uppermost being almost superior. Carpels many whorled, sunk in the torus and forming a syncarpous ovary with concave top and radiating stigmas. Fruit spongy, maturing under water and irregularly breaking up.

L. sharply sinuate-toothed. Sepals ribbed. Anthers not appendaged. Fls. red to white . . . . 1. *lotus*.
L. obtusely sinuate or entire.
Sepals scarcely ribbed. Anthers scarcely appendaged. Fls. white . . . . 2. *esculenta*.
Sepals veined, not ribbed. Anthers appendaged. Fls. blue to white . . . . 3. *stellata*.

1. **N. lotus,** *L.* Kumuda, *Sans.*; Koka, Koi, *H.* (the flower); Saluka, *Beng.*; the White Indian Water Lily; Raktopala, *Sans.*; Rakta Chandana, Sandaka, *H.*; Rakta-Kambala, *Beng.*; The Red Indian Water Lily.

Rhizome nodular, large, over 3″ usually 4″ diam. Leaves usually pubescent beneath, strongly veined, the veins repeatedly bifurcate. Flowers usually large and over 3″. Connective of anthers not at all, or very slightly, produced beyond the cells. Carpels 10–20. Stigmatic rays clubbed.

Var α. **lotus** proper. Flowers white or pink.

Var β. **rubra**. *N. rubra*, Roxb. Flowers red or crimson. Throughout the province in fresh water, tanks, etc.

The tubers and seeds are eaten, the tubers sometimes eaten raw and the seeds after being parched.

2. **N. esculenta,** *Roxb.* *N. lotus* var *esculenta, F.B.I.*; Chota Sundi, *Beng.*; Small White Indian Water Lily.

Corm small, ovoid, 2–3″. Leaves somewhat pubescent beneath, nerves more reticulate and less strong. Flowers white, under 3·5″ Connective of anthers usually slightly produced, but not foliaceous. Carpels 10–15. Stigmas incurved.

The tubers are considered superior to any other kind according to Roxburgh. This species seems intermediate between 1 and 3.

3. **N. stellata,** *Willd.* Syn. N. cyanea, *Roxb.*; N. versicolor, *Roxb.*; Nilotpala, *Sans.*; Bhengt, *H.*; Sundi, Nilpadma, Nilsaphala, *Beng.*; The Blue Water Lily.

Corm as in *esculenta*, not nodular. Leaves glabrous, entire or slightly sinuate, nerves beneath more reticulate and less strong than in *N. lotus.* Flowers usually blue, sometimes white or pink. Apices of the anthers appendaged or foliaceous, often coloured.

Var. α. **stellata** proper. Fls. azure, only 2″ diam. Petals only 8 and stigma 8-rayed (*Roxburgh*).

Var. β. **versicolor,** *Roxb.* Fls. white or pink. Roxburgh says the sinus of the leaves is wedge-shaped and the fruit 15-celled.

Var. γ. **major,** *Voight.* Fls. pale blue, 4-5″ diam. Petals 8-12″. Fr. 10-12-celled. Ranchi, Singbhum, etc.!

The species is found throughout the province. The description of the varieties is founded on Roxburgh. Their distribution has not been noted.

2. EURYALE, *Salisb.*

Very prickly aquatics with orbicular floating leaves, more or less corrugate or bullate above and with very prominent nervation beneath. Sepals 4, inserted on the torus above the level of the ovary, together with the many seriate petals, which pass gradually

into the sepals and stamens; the latter are in bundles of 8, innermost stamens sterile. Carpels 8, many sunk deeply in the torus, connate in a single whorl. Ovules few. Fruit spongy. Albumen floury.

1. **E. ferox,** *Salisb.* Syn. Anneslea spinosa, *Roxb.*; Makhana, *H.*; Kanta Padma, *Or.*

Scarcely rhizomatous. Leaves deep purple beneath, prickly on the nerves. Petioles prickly. Flowers a lovely violet-blue, or bright red, under 2″. Fruit 2–4″, prickly, gradually irregularly breaking up. Seeds about 20, arilled.

B. & O., locality not noted, probably Purneah! Purneah, *Buch. Ham.* The plant was recognisable from the prickles but not in flower! Fls. most of the year.
The farinaceous seeds are largely eaten (*Roxb.*, *Ham.*). They are called *Makhanna* in Sans, and are said to be suited for sick people (Dutt.).

3. NELUMBIUM, *Juss.* The Sacred Lotus.

A large, beautiful aquatic, with milky juice and stout creeping rhizome. Leaves floating and also raised high above the water, peltate. Sepals, petals and stamens spirally arranged, passing gradually into one another: anthers clavate at the end. Carpels many, irregularly sunk in the flat top of the large fleshy obconic torus, laterally attached. Ovules 1–2. Fruiting torus spongy and dry, containing the dry, ripe, loose carpels in its cavities.

1. **N. speciosum,** *Willd.* Padma, Kamala, *Sans.* (Pundarik, the white variety, Kokanada, the red variety); Shwet Padma and Rakta Padma, *Beng.*

Peduncles and petioles often raised high above the water, sometimes with weak prickles. Flowers white or rose-coloured like immense roses.

On tanks, etc., throughout the province. Fls. April–July. Fr. Dec.–Jan.
This very sacred plant of the Hindus and Buddhists had various names given to its several parts; the whole plant was called *Padmini*, the flowers as above, the torus *Karnikara*, the filaments *Kinjalka*, etc.
Hamilton says the fruit is called *Chaka* in Purneah, the root *Mrinab*, and eaten raw or cooked. The plant is called *Bisangr* in H.
The internodes of the rhizome and the seeds are eaten; the leaves are used for plates.

FAM. 8. PAPAVERACEÆ.

Herbs with milky, often yellow juice. Leaves radical or alternate exstipulate. Flowers often showy, regular. Sepals 2 (or 3). Petals 2 + 2 (or 3 + 3). Stamens ∝. Ovary 1-celled, with 2–several parietal, often lamelliform placentæ and many ovules. Stigmas many, radiating but often connate. Fruit capsular, dehiscing by pores or valves. Seeds many, small, with fleshy and oily albumen. Embryo minute.

Sepals 2. Petals 4. Capsules globose . . . . 1. *Papaver.*
Sepals 3. Petals 6. Capsules oblong . . . . 2. *Argemone.*

1. PAPAVER, *L.* Poppy.

Leaves lobed or cut, not prickly. Stigmas sessile, radiating, connate, peltate or pyramidal, with many short free lobes. Capsule short, opening by small valves under the lobes.

1. **P. somniferum**, *L.* Pasto, *Beng.*; Aphim (Opium), *Vern.*; The Opium Poppy.

A stout herb, 2–4 ft., glaucous, with oblong amplexicaul lobed, toothed and serrate leaves and large, usually white flowers. Sepals glabrous. Capsule large, 1″ diam. Seeds usually white (or black, *F.B.I.*).

It used to be largely cultivated in the Northern Tract, and feral plants may still be found.

2. ARGEMONE, *L.*

An erect, thistle-like annual with yellow juice and bright yellow flowers. Sepals 2–3. Petals 4–6. Stigma 4–7-lobed on a very short style. Capsule oblong, usually with prickles, dehiscing by short valves alternating with the stigmas.

1. **A. mexicana,** *L.* Siyal-Kanta, Kari-Kanta, *K.*, *Beng.*; Gokhula janum, *S.*; Deng Bejari, Sarpuni, *Or.*

A prickly herb 2–3 ft. with sinuate pinnatifid green and white leaves which are half amplexicaul. Flowers 2″ diam. Sepals cuspidate. Capsules ·75–1·5″ long.

Naturalised (from America) and very common in waste ground. Fls. Feb.–June and more or less throughout the year.

The seeds, which are often found collected into little heaps by ants, yield an oil which is used for lighting and anointing purposes.

FAM. 9. FUMARIACEÆ.

Herbs with watery juice and usually lobed or dissected, alternate, rarely opposite leaves. Flowers *irregular* racemose. Sepals 2, very small and deciduous. Pet. 2 + 2, 2 outer larger, one or both gibbous or spurred, 2 inner erect, often coherent at the tip. Stamens 6, in two bundles opposite the outer petals, lateral in each bundle with 1-celled anthers. Ovary 1-celled, stigma simple or lobed. Ovules 2 or more, parietal. Fruit a 2-valved capsule or indehiscent and then only 1-seeded. Seeds albuminous.

1. FUMARIA, *L.* Fumitory.

Sometimes scandent. Leaves dissected with very narrow segments. One outer petal obtusely spurred. Stamens 6, diadelphous. Ovules 2. Fruit indehiscent, 1-seeded.

1. **F. parviflora,** *Lamk.* Pit papra, *H.*; Ban-salpha, *Beng.*

A diffuse much-branched annual glaucous weed, with flat linear leaf segments and small whitish or rose-coloured flowers, ·2–·3″ long with purple tips to the petals. Racemes ·5–1″. Sepals lanceolate. Fruit globose, rugose when dry with 2 pits at the top.

Cultivated fields, chiefly in the Northern Tract, Bettiah! Fls., Fr. c.s. to March. This is one of the species of Fumitory which is found in England, and distinguished by the very small sepals and pedicels exceeding the bracts.

FAM. 10. CRUCIFERÆ.

Herbs with watery juice and simple or pinnate, entire or cut, exstipulate alternate leaves. Flowers regular or outer radiant. Sepals 4, free. Petals 4, hypogynous, spreading, imbricate or convolute. Disc glands usually 4, sessile opposite the sepals. Stamens 6, tetradynamous, 4 longer opposite the median sepals approximate in pairs, very rarely stamens only 4 or 2. Ovary syncarpous, of 2 lateral carpels, 1-locular, or most usually spuriously 2-locular by a longitudinal membranous partition (*replum*) connecting the two parietal placentæ, the edges of the replum itself being placentiferous, more rarely divided by transverse partitions. Ovules 1–2 or ∝, campylotropous, or amphitropous. Fruit usually elongate, pod-like and 2-valved (*Silique*), the valves breaking away from the replum, or short dehiscent or indehiscent. Seed exalbuminous. Cotyledons large, with the radicle turned up on the back of one (*incumbent*) or along their edges (*accumbent*).

A family of great economic importance with many well-known esculent vegetables (Cabbage, Cauliflower, Knolkhol, Turnip, etc.) not here described, and several garden plants, some of which may occasionally be found as escapes. Some cultivated forms of Brassica have more than 2 carpels and pod-valves, and the replum is then often absent.

1. Fr. a silique with broad replum (silique rather short in 2).
   - A. Sepals gibbous at the base. Silique with a beak. Fls. usually yellow.
     - Silique long. Seeds 1-seriate . . . . 1. *Brassica.*
     - Silique rather short, turgid. Seeds 2-seriate . . . 2. *Eruca.*
   - B. Sepals not gibbous at the base. Silique not beaked.
     - Fls. usually yellow. Sepals spreading. Pod turgid . . 3. *Nasturtium.*
     - Fls. white or rose. Sepals erect. Pod flat . . . . 4. *Cardamine.*
2. Fr. short and broad (siliculus) with broad replum.
   - Glabrous. Fls. white or yellow . . . . 5. *Cochlearia.*
   - Hoary. Fls. white . . . . 6. *Alyssum.*
3. Fr. a siliculus, compressed, with narrow replum. Fls. white.
   - Pods obcordate or cuneate, not winged . . . . . 7. *Capsella.*
   - Pods ovate or oblong, or orbicular, not winged . . . 8. *Lepidium.*
   - Pods winged or keeled . . . . 9. *Thlaspi.*
4. Fr. indehiscent.
   - Racemes contracted, leaf-opposed. Fr. small, didymous . 10. *Senebiera.*
   - Racemes elongate. Pod large, often septate . . . . 11. *Raphanus.*

1. BRASSICA, *L.*

Leaves entire, lyrate or pinnatifid. Lateral sepals saccate or gibbous at base. Petals with long claws, yellow, rarely white. Pod with a seedless indehiscent beak, sometimes 3–4-valved (in cultivation), replum membranous. Seeds globose, cotyledons incumbent.

1. Cauline L. amplexicaul, base usually auricled.
   - L. all, or young only, hairy, covered with a pale bloom . . 1. *campestris.*
   - L. quite glabrous, a faint bloom only beneath . . . . 2. *napus.*
2. Cauline L. not amplexicaul, narrowed to their base . . . 3. *juncea.*

There is much difference of opinion as to the best limitation of the species and varieties of this genus. The above characters of *campestris* and *napus* are after Prain, but I admit that I have not found them easy to work, and it is perhaps preferable to consider both as forms of one species, *campestris*, as in the *F.B.I.*

The common Turnip is *B. rapa, L.*, var. *rapifera* (or *B. campestris*, sub-sp. *rapa*), Salgam, *H.*, *Beng.*

Brassica oleracea, L., and its varieties include the Cabbage, Kobi, *Vern.*; Cauliflower, Phul-kobi, *Vern.*; Kohlrabi or Knolkohl, Band-kobi or Gol-kobi, *Vern.* They are largely cultivated in European gardens in the cold season.

1. **B. campestris,** *L.*

An erect rather stout herb often with a swollen tap-root; lower leaves lyrate hispid or hairy,* upper amplexicaul and auricled, oblong or lanceolate, covered with a glaucous or grey bloom. Pod with a flat seedless beak.

Fls., Fr. c.s.

Var. **oleifera,** *DC.* Rape, Colza.

Very stout, with stems as thick as the finger, ending in a swollen spindle-shaped root. L. up to 8″ by 3″ with large lobes 1·5″. Pods slender, ***beaded.*** Appears to be cultivated at the Government farms only.

Var. **sarson,** Prain ('Bengal Plants,' p. 220). Sarson, *H.*; Swet-sarisha, swet-rai, *Beng.*

Stout but with slender roots. L. up to 10″, lowest not amplexicaul; upper up to 5″, auricled. Pods stout, 2″ by ·25″, ***not at all beaded.*** Seeds white or black. Prain states that there are two races, *Natua sarson* (*Sinapis glauca*, Roxb.) with erect pods, and *Ulti sarson*, with pendant pods; that the first is generally cultivated (it is, however, rare in our area), and the second slightly cultivated in Eastern Behar and perhaps in Purneah. Roxburgh, however, says of his *S. glauca* or *Shwet Rai* that the leaves are everywhere glabrous (so that it should come under the next species)! and glaucous, lower lyrate, upper sub-lanceolate. Seed white.
Gives colza oil. Roxburgh says much used in the diet of the Hindus.

Var. **esculenta,** *DC.* Pods small, not beaded. The roots and leaves are eaten.

2. **B. napus,** *L.*, var. **dichotoma,** *Prain.* Syn. B. campestris, sub.-sp. napus; 'F.B.I.,' in part; Sinapis dichotoma, *Roxb.*; Turi, Tori, *H.*; Sanchi, sarsi, sada rai, *Beng.*; Mani, *K.*; Indian Rape, Mustard.

A more slender plant than *campestris* and quite glabrous, rather glaucous. Radicle and lower cauline leaves lyrate pinnatifid, less lobed than in *campestris* and often only 3″. Fls. ·4–·5″ diam., pale golden yellow. Sepals erect or erecto-patent. Pods 1·5–2″, including a beak ·5–·7″, erecto-patent, on pedicels ·6–·75″ long, glabrous. Seeds about 16.

The commonest cultivated species, especially in Chota Nagpur, forming fields of a beautiful yellow in the early part of the cold season. In all the districts!
There are two varieties—*Lotni Turi* (Lutni, *S.*) with seeds black, and *Taria Turi* (Thadia-turi, *S.*) with seeds yellow.
The young L. are eaten as a vegetable, but it is grown mainly for the oil, not locally for mustard. Mustard oil is said by Indians to promote the growth of the hair, and to keep the skin soft and wholesome.
The mustard of commerce is officially given as the seed of *B. nigra* and *B. alba*, both with only 1–5 seeds in the pod, though *B. juncea* is also used, and "white Indian mustard seed" is also exported, and is probably *B. campestris.*
Wood (*Plants of Chutia Nagpur*) records both *B. alba*, H. f. & T., and *B. nigra*, Koch, from Chota Nagpur with the vernacular name of Sirsu, but I have seen no specimens.

3. **B. juncea,** *H. f. & T.* Sinapis ramosa, *Roxb.*; Rai, *H. S.*; Rai sarisha, *Beng.*; Mustard.

Stout or slender with long-petioled leaves, not amplexicaul, attaining 12″, but often quite small, especially in feral states; there are often small leaflets or auricles along the petiole. Glabrous, or a few soft white hairs near base of plant, and leaves sometimes scabrous, lower lyrate, upper lobate to entire. Flowers bright yellow, pedicels and

* But see under var. *sarson.*

calyx spreading. Pod 1–2″, somewhat vertically compressed, and beak very short acuminate. Seeds dark brown, reticulate.

In all the provinces, including Chota Nagpur, f. *Prain;* not common in Chota Nagpur, Manbhum! Fl., Fr. c.s. from Sept.

The often very short beak well distinguishes the pod of this species. The seeds are used for the oil, and also exported for mustard. The seeds are rather larger and more oblong than those of preceding species. Campbell says it is largely cultivated on bari land.

2. ERUCA, *Tourn.*

Brassica-like herbs, but flowers sometimes white or lilac, petals veined. Seeds numerous, 2-seriate-globose.

1. **E. sativa,** *Lamk.* Brassica erucoides, *Roxb.*; Swet sarish, *Beng.*; Taranuri, *H.*

A mustard-like herb with hairy or glabrescent stems, unevenly pinnatifid leaves 3–7″ long, usually with linear-oblong segments, rarely sub-entire, sometimes twice pinnatifid. Flowers white or veined, ·5″ diam., on pedicels shorter than the calyx. Sepals erect, ·38–·4″. Pods erect and appressed to the rachis, turgid, ·75–·9″, including the flattened beak, which is half as long or more as the seeding portion.

Banks of the Ganges, *T.T.*! Possibly in the Northern Tract. Chota Nagpur, f. *Wood.*
Fls., Fr. Sept.

3. NASTURTIUM, *R. Br.*

Terrestrial or aquatic herbs, with entire lobed or pinnatifid leaves and small yellow, rarely white, flowers. Sepals short, spreading, not saccate. Petals short, scarcely clawed. Silique long or short, nearly terete. Stigma entire or two-lobed. Seeds small two-seriate or irregularly 1-seriate, cotyledons accumbent.

A. Fls. yellow.
  L. lyrate-pinnatifid. Pods short-oblong . . . . 1. *palustre.*
  L. not lyrate. Pods linear-oblong . . . . 2. *indicum.*
B. Fls. white. The water-cress . . . . 3. *officinale.*

1. **N. palustre,** *D.C.*

Glabrous except a few small hairs on the auricles at base of leaves. Leaves lyrate-pinnatifid. Flowers small, yellow, in elongate racemes. Pods ·25–·3″ long by ·1–·12″ broad, on spreading or reflexed pedicels three-fourths to as long as themselves, often upcurved.

In wet places north of the Ganges, but not common! Fls., Fr. Oct.–May.

2. **N. indicum,** *D. C.* Syn. Sinapis divaricata, *Roxb.*

Usually pubescent all over but sometimes glabrous. Leaves 2-pinnatisect or pinnatisect and pinnatifid or gashed and toothed, more rarely simple oblanceolate, coarsely toothed. Flowers small, yellow, racemed. Pods linear, rarely linear-oblong, ·5–·7″ long, on spreading or erecto-patent short pedicels rarely half as long as the pod.

Common in Northern Area, also in gardens (Ranchi) as a weed in Central Area! Fls., Fr. Oct.–April.

3. **N. officinale,** *Br.* The common water-cress is cultivated in Chota Nagpur, *Wood.*

4. CARDAMINE, *L.*

Leaves entire, lobed or pinnate, often flaccid. Flowers usually white to violet. Sepals not gibbous. Petals clawed. Pod narrow-linear compressed, tapering both ends, but not beaked, valves with distinct midrib curling up elastically on dehiscence. Seeds 1-seriate, compressed, cotyledons accumbent.

1. **C. hirsuta,** *L.*, var. **sylvatica.** C. debilis, *Don, B.P.*; C. flexuosa, *Withering.*

A small erect, or branched from the root, glabrous plant 3–9″ high with pinnate leaves, very small white flowers in terminal racemes and linear pods, ·6–·9″ long, erect

Not very common. On damp walls, Ranchi! and probably in Northern Area. Fls., Fr. July–Nov.
Leaflets usually small and rounded, petiolated, often dentate or lobulate. Petals narrow, erect. Stamens 6.

5. COCHLEARIA, *L.* Scurvy-grass.

Glabrous, often fleshy, with entire or pinnatifid leaves. Flowers white, yellow or violet, shortly racemed or corymbose. Sepals spreading. Pods globose, ovoid or oblong, with convex turgid valves. Seeds compressed, cotyledons accumbent.

1. **C. flava,** *Ham.*

A diffusely-branched annual; branches 6–15″, with pinnatifid and toothed leaves 1–3″ long, and elongated racemes of very small white or yellow flowers and sub-globose pods ·2″ long.

Not uncommon in the Northern Area on river banks. Dehri-on-Soane! Patna! Soane, alluvial lands (*J.D.H.*)! Monghyr!
Fls., Fr. July–Feb.
Said to be used for fever.

6. ALYSSUM, *L.*

1. **A. maritimum,** *L.*

A diffuse herb with branches 6–10″, sparsely clothed like the leaves with adpressed 2-partite hairs. Leaves linear-oblanceolate, entire, 1–2″. Flowers small, white, in dense terminal racemes at the ends of the branches, sub-corymbose when young. Pods orbicular-ellipsoid, ·1″, cells 1-seeded.

Near gardens in the Northern Area. Fls. c.s.

7. CAPSELLA, *Moench.* Shepherd's Purse.

Small weeds with rosulate entire or pinnatifid leaves and very small white, racemed flowers. Pods obcordate-cuneate, much laterally compressed, so that the replum is very narrow. Seeds many, 2-seriate, narrowly-margined, cotyledons incumbent.

1. **C. bursa-pastoris,** *Moench.*

The well-known little European weed which is occasionally found in the northern area during the cold season. Height 3–12″. Cauline

leaves amplexicaul auricled. Flowers ·08″ diam. Siliculus ·25–·3″ on slender pedicels. Seeds oblong punctate.

Fls. c.s.

8. LEPIDIUM, *L.* Cress.

1. **L. sativum,** *L.* Halim, alevari, *Vern.* Common Cress.

Herb 1–3 ft. high, glabrous or slightly hairy. Lower leaves 1–2-pinnate, upper pinnatifid or lobed with oblong obcuneate or linear lobes. Flowers very small, white, in elongating racemes. Pods ·2″, numerous, broadly-elliptic, compressed, with an apical notch containing the short style. Pedicels sub-erect, scarcely as long as the pod,

Cultivated and as an escape, but not common. Northern Tract; along Soane River (*J.D.H.*)! Chota Nagpur (*Wood*).

9. THLASPI, *L.* Penny Cress.

1. **T. arvense,** *L.*

An erect herb 6–18″, usually single, with radical, rosulate, petioled leaves, soon disappearing, and cauline leaves, amplexicaul, suberect, sagittate, sinuate-toothed, glabrous. Flowers ·2″, white, in elongating terminal racemes. Pods suborbicular, laterally compressed, ·5–·7″ long, somewhat broader upwards, winged, and with a deep notch containing the very short style; pedicels slender, patent.

A weed of cultivation, rare in the Northern Tract; Champaran!
Fls. Sept.

10. SENEBIERA, *DC.* Wart-Cress.

1. **S. pinnatifida,** *DC.* Syn. S. didyma, *Pers.*

A diffuse, branched, small leafy herb with finely-cut 1–2-pinnatifid leaves 1–2″ long, very minute, white, usually apetalous and 2-androus flowers in numerous leaf-opposed racemes, ·75–2″ long and small, close didymous pods, consisting of two wrinkled indehiscent lobes which separate on falling. Seed, 1 in each lobe, reniform.

It occurs in Calcutta and in the United Provinces (at Banda), so will probably be found in Bihar and Orissa.
Fls., Fr. Jan.-Feb.

11. RAPHANUS, *L.* Radish.

Annuals or biennials with lyrate-pinnate or pinnatifid leaves and moderate-sized or large white, or purple, flowers in long ebracteate racemes. Sepals erect, the lateral saccate at base. Pods indehiscent, elongate, terete and swollen, with a long acuminate beak, 1- or several-celled within by transverse pithy septa. Seeds globose or ovoid, cotyledons conduplicate, retuse. Radicle incumbent.

The genus is closely allied to *Brassica.*

1. **R. sativus,** *L.* Morai, *K.*; Mula, Muli, *Beng.*; Purabi sarisha, Seuti sarisha, Tora, *H.*

It is frequently cultivated as a crop in our area! Fls., Fr. Jan.-Feb.
A herb 2–3 ft. with the radical and lower cauline L. usually lyrate pinnatifid, but sometimes terminal lobe not much larger than others, usually coarsely toothed

and hispid; upper not amplexicaul nor auricled, linear. Fls. usually white. Sepals ·25-·35″. Petals narrowly obovate, rather persistent. Pods 1·5″, suberect or spreading, 2–8-seeded and jointed, usually filled with pith between the large seeds. Funicle of ovules short and flat.

Some forms resemble *Eruca* without the fruit. It can be distinguished by the long pedicels, ·4″ or more, and shorter sepals, as well as the 1-seriate ovules. The root in feral states is very hard. The root and seeds yield an oil for which it is chiefly cultivated in Purneah. Root largely eaten and also unripe fruits.

FAM. 11. CAPPARIDACEÆ.

Herbs, shrubs or trees, sometimes climbing by means of stipulary prickles; stipules sometimes 0. Leaves simple or digitate. Flowers solitary umbelled or racemed or in extra-axillary vertical rows. Sepals 4. Petals 4, hypogynous or on a large disc. Stamens 4–∞, sometimes on a gonophore. Ovary usually on a gynophore or gynandrophore, which may become long and woody in fruit, 1-celled, with 2–4 parietal placentæ and numerous campylotropous ovules. Style short or 0, stigma depressed or capitate. Fruit capsular or baccate. Seeds exalbuminous, embryo incurved, often spiral.

1. Herbs with oblong or linear capsules.
   Gonophore 0, gynophore short or 0 . . . . 1. *Cleome.*
   Gynandrophore with 6 stamens only . . . . 2. *Gynandropsis.*
2. Shrubs or trees, sometimes scandent. Fr. baccate.
   Sepals open in bud, adnate below to disc . . . . . . 3. *Cratæva.*
   Sepals closed in bud, free, 2-seriate . . . . 4. *Capparis.*

1. CLEOME, *L.*

Herbs with simple or digitate leaves and racemose yellow or red flowers. Gonophore 0. Ovules many on 2 parietal placentæ. Fruit an oblong or linear capsule with 2 valves, which separate from the seed-bearing placenta. Seeds reniform.

L. simple . . . . 1. *monophylla.*
L. digitate.
   Fls. yellow. L. glandular pubescent . . . . . . 2. *viscosa.*
   Fls. rose- or violet-coloured. L. not glandular . . . 3. *Chelidonii.*

1. **C. monophylla,** *L.* Hurhura (viewed as a pot-herb), Kedar jhawar (as a medicine), *S.*; Chamani, *K.*

A pubescent and glandular branched herb 1–2½ ft. high with oblong or oblong-lanceolate or ovate-lanceolate leaves 1–2″ long, of which the lower are petioled, and elongating leafy racemes of dull or pale purple flowers in the axils of petioled bracts. Sepals linear. Petals long-clawed, ·25″, stamens 6. Ovary glandular, elongating into a linear capsule, 2–4″.

Common and probably found in all districts. Fl., r. s.

The L. are eaten as a pot-herb. The pounded root is put on the lips (by the Santals) to restore consciousness when in a faint (*Campbell*).

2. **C. viscosa,** *L.* Chamani, *K.*; Harhara, *S.*; Hurhuria, *Beng.*

An erect pubescent and glandular herb, 1–3 ft. high, with 3–5-foliolate leaves, ovate to obovate leaflets and long-pedicelled yellow

flowers in long racemes. Petals ·5″. Stamens 12 or more. Capsule 2–3″, striate, glandular pubescent.

Very common throughout the area. Fl., Fr., r. s.
The seeds are said to have the same properties as mustard, and are regarded as anthelmintic, carminative and stimulant; externally they act as a vesicant. They give a fixed oil.

3. **C. chelidonii,** *L. f.* Syn. Polanisia chelidonii, *DC.*

A pretty species 2–3 ft. high, somewhat scabrid but without hairs. Leaves 5–9-foliolate, with obovate leaflets or upper 3-foliolate with linear leaflets (*Polanisia angulata, DC.*). Flowers 1″ long-pedicelled. Stamens very numerous.

Watery places, not common. Santal Parganas! Orissa! Fls. July–Sept. The seeds are said to be used in curries.

2. GYNANDROPSIS, *DC.*

Differs from *Cleome* in that there is a well-marked gynandrophore. The æstivation also is open, whereas the petals of *Cleome* are imbricate in bud.

1. **G. pentaphylla,** *DC.* Chamani, *K*; Seta kata arak, *S.* (f. *Campbell*); Sada hurhuria, *Beng.* (f. *Prain*).

A very common strong-smelling, somewhat fœtid weed, 1–3 ft. high, with digitate long-petioled leaves, 5 sessile, unequal, obovate, glandular-hairy leaflets, and elongating corymbiform racemes of purple or white flowers ·3–·7″ diam. and 3-foliolate bracts. Anthers purple.

Throughout the area. Fls. July–August.
It is eaten as a sag (arak) by the Santals and Kols.

3. CRATÆVA, *L.*

Trees with digitately 3-foliolate leaves and large white yellow or purplish flowers. Sepals cohering below with the lobed disc. Petals 4, long-clawed, open in bud. Stamens many, adnate to the base of the long slender gynophore. Ovary 1-celled, ovules many. Fruit baccate.

1. **C. religiosa,** *Forst.* Barun, Varuna, *H., Beng., Or.*

A small spreading tree, very handsome in flower when covered with its terminal corymbs of flowers, which vary in colour from white and cream to yellow and pink with purple stamens, and are 2–2·5″ diam.

Chiefly along rivers and streams. Rare in C. N. (Salai, Dighia, etc.)! Puri and Cuttack frequent, becoming a dwarf shrub on the coast at Chandpur! Narsingpur jungles! Along the Mahanadi River! Frequently cultivated all over the province.
Fls. March–April, mostly with the L., but sometimes before the new L. Fr. June. Deciduous Jan.–March.
Twigs with white lenticels. Leaflets ovate to lanceolate, gradually or abruptly (var. *Nurvala*) acuminate, pale beneath, about 4·5″. Pet. ·7–1·25″. Gynophore 2″ or more. Berry yellow globose, 1″ diam., or ovoid (var. *Nurvala*).
Wood used for combs, *Cooper*. Fr. sometimes eaten.

4. CAPPARIS, *L.*

Trees or shrubs usually climbing. Leaves simple, often with stipulary thorns. Petals not clawed. Stamens at base of the long gynophore. Ovary on the gynophore 1–4-celled. Fruit baccate, but often hard. Seeds many, cotyledons spirally rolled.

1. Fls. solitary axillary. Thorns straight or curved. Branching shrubs.
   L. orbicular . . . . 1. *spinosa.*
   L. oblong or ovate-lanceolate . . . . 2. *brevispina.*
2. Fls. 1–several in vertical supra-axillary lines. Climber, thorns curved . . . . 3. *horrida.*
3. Fls. in terminal umbels or corymbs. Climbers (sometimes erect in 5).
   A. Fls. large, 3″ diam. L. 1·5–3·7″ . . . . 4. *Roxburghii.*
   B. Fls. small, ·25″–·5″ diam.
   Corymbs simple. Stamens many . . . . 5. *sepiaria.*
   Corymbs panicled. Stamens few . . . . 6. *floribunda.*

1. **C. spinosa,** *L.* Var. **leucophylla,** *DC.* (sp.). The Caper Plant; Kabara, *H.*

A much-branched prostrate shrub, hoary, with a white pubescence, with orbicular or broadly ovate leaves, 1–2″, and white solitary axillary flowers with purple filaments. Fruit 1·5–2″, ovoid or oblong.

Stony valleys in Bettiah, rare. Fls., Fr. (not seen).

The pickled buds form the "capers" of commerce. The plant is more common in the Western Himalayas and Afghanistan, and is distributed to West Asia and N. Africa, also Europe and Australia.

2. **C. brevispina,** *DC.* Syn. C. zeylanica, *F.B.I.*; Lephura, Niphura, *Or.*

A rigid, much branched shrub with small straight stipulary thorns, oblong or narrow-elliptic, very coriaceous leaves, 1–2″, and white and yellowish flowers about 2″ diam. (with stamens) in the axils of the terminal leaves on slender pedicels, sometimes 1–3, terminating short shoots. Ovary lanceolate in outline, pubescent or tomentose.

Puri (Kuhuri Hill in forest! Protap and Krushnanagarh Block, usually in dry scrub, *Haslett*! Rocky shores of Chilka Lake!)

Fls. April–May. Fr. May (ripens probably June).

Branches stout, twigs covered with small warts or papillæ and young also flocculent or tomentose. Tufts of rigid setæ above the leaf axils are peculiar and may represent rudimentary shoots. L. sometimes somewhat ovate-lanceolate, base rounded, tip obtuse or acute and mucronate; both surfaces reticulate with raised nervules and strong marginal nerves, glabrous. Petioles ·05–·15″. Spines ·05–·2″. Pedicels slender, about ·7″. Sepals lanceolate, ·3″. Petals ·8″, oblanceolate. Fr. (young) 1·5″, ovoid to fusiform. "Like a fat chilli, deep red when ripe and eaten after boiling," *Haslett.*

3. **C. horrida,** *L.f.* Syn. C. zeylanica, *L.** Gaterna, *K.*; Buru asaria, *S.*; Bagnai, *Beng.*; Bagnahim, Kharw.; Oserwa, Asadua, *Or.*

A shrub, scrambling or climbing by means of its recurved thorns, densely brown tomentose on the shoots, with usually ovate leaves 2–3″ long and white or pink flowers 1·5–2″ diam., which are sub-

* According to *The Flora of Madras, C. zeylanica*, L., is the original name of this plant. Prain, on the other hand, says—"Not of Linn." In any case it appears very inadvisable to retain the name *zeylanica*, which has for so long been used for another plant.

solitary or in vertical lines above the leaf axils, sometimes appearing panicled from the leaves being undeveloped at the time of flowering, and occasionally on short lateral shoots. Ovary globose or broadly ovoid glabrous on a very slender gynophore over 1″ long.

In hedges and thickets and along rocky nalas. Common throughout the province! Fls. March–May. Fr. Sept.–Oct.

L. from narrow elliptic to orbicular-obovate, attaining 2·5″; shining above, base usually narrowed, tip mucronate, venation reticulate. Petioles ·2″ or larger. Calyx brown or purple. Petals and filaments usually purple with age. Berry broadly ellipsoid to globose, 1·5″ diam., red when ripe on a gynophore often 2″ long.

4. **C. Roxburghii,** *DC.* Handiphuta, *Or.*

A very beautiful large woody climber with hoary branches, oblong leaves and pure white flowers, 3″ diam. (with the stamens), in terminal corymbs. Buds and ovary globose and glabrous.

Puri, in rocky jungles, frequent! Fls. April–May. Fr. Sept.–Oct.

Trunk attains 3″ diam. with light grey bark furnished with large conical geminate bosses tipped by a spine. Blaze brown. Branches with a minute ashy tomentum, unarmed or with small recurved spines. L. 1·5–3·7″ by 1–1·7″ sometimes somewhat obovate-oblong; tip rounded glabrous, above shining. Petioles ·5″. Lower flowers of corymb sometimes axillary with pedicels 1–1·5″ long. Sepals very concave orbicular, ·4″, glabrous or ciliate. Petals ·8″, oblanceolate, villous within, unilateral Stamens very many, 1·5″, caducous. Gynophore 1·5″. Fr. green globose, 2″ diam.

5. **C. sepiaria,** *L.* Kaliakara, *Beng.*; Kantikapali, *Or.*

A large erect, sarmentose or sub-scandent wiry bush with grey-tomentose or hoary branches, sharp curved stipulary thorns, leaves ·5–1·7″ long, and small white flowers umbellate at the ends of the branchlets with very slender pedicels. Fruit globose, black, ·2″ diam.

Palamau and Shahabad, chiefly in the dry scrubby zone near the Soane! Scrub jungles of Puri district, common!

Fls. April–Dec. Fr. Nov.–Dec.

L. mostly elliptic-oblong, or obovate in Northern and ovate-oblong or ovate-lanceolate in Southern specimens; base obtuse rounded or sub-cordate; tip subacute or retuse, tomentose when young, old slightly pubescent. Petioles ·05–·15″. Pedicels from uppermost axils and terminal ·25–5″. Sepals and petals ·12″. Stamens ·2–·3″. Ovary very small.

6. **C. floribunda,** *Wight.*

A large woody climber with glabrous branches and coriaceous glabrous oblong leaves, 3–5″, rounded at both ends, retuse and apiculate. Flowers ·5″ diam., white, in many flowered umbels, which are arranged in large panicles. Petals oblong. Stamens about 8. Ovary ovoid acute. Fruit globose, 1″ diam.

Orissa, Cleghorn (f. *F.B.I.*); Kahuri Forest, Puri!

FAM. 12. VIOLACEÆ.

Herbs (in our area) with alternate, rarely opposite, entire or pinnatisect stipulate leaves. Flowers irregular, 2-bracteolate. Sepals 5, persistent, imbricate. Petals 5, hypogynous, the lower dissimilar, often saccate or spurred. Stamens 5, hypogynous or slightly peri-

gynous. Anthers erect, conniving in a ring round the ovary, connective often dilated and produced, cells dehiscing by a longitudinal slit or by apical pores. Ovary 1-celled, style 1, stigma entire or 3-lobed. Ovules many, anatropous, on 3 parietal placentæ. Fruit a 3-valved loculicidal capsule.

Sepals produced at the base . . . . 1. *Viola.*
Sepals not produced at the base . . . . 2. *Ionidium.*

1. VIOLA, *L.* Violet, Pansy.

Herbs, sometimes woody below. Flowers on 1–2-flowered peduncles, some sometimes cleistogamous and small, but ripening many seeds. Sepals produced at the base. Petals erect or spreading, lower largest, spurred or saccate. Anthers connate, two lower often spurred.

1. **V. Patrinii,** *DC.*

Herb with a perennial rootstock and numerous leaves direct from the stock, sagittate or hastate, 1–3″ long and crenate, the base cuneate on a very long petiole, which is winged above. Flowers lilac, the anterior petal with spur about ·5″ long, but small cleistogamous colourless flowers only ·15″, on peduncles often 6″ long, direct from the stock.

Higher mountains of Chota Nagpur, Neterhat, 3000 ft.
Fls., Fr. May–Aug.

2. **V. tricolor,** *L.* The Heartsease.

This is said to occur wild in cultivated fields on the Pakripat, 3000 ft., but I have not seen it.

Both *V. tricolor*, L., the garden pansy, and *V. odorata*, L., the sweet violet, are largely cultivated in gardens. The first is annual. The violet is perennial, but is apt to be attacked by mildew in the rains and killed off.

2. IONIDIUM, *Vent.*

Herbs or undershrubs with alternate, rarely opposite leaves and axillary rose-, purple- or orange-coloured flowers. Sepals subequal, not produced at the base. Petals with lower larger clawed, saccate or spurred. Anthers free or connate, 2 or 4 of them gibbous or spurred. Ovary ovoid, style clavate, incurved, with oblique stigma. Capsule subglobose, few-seeded.

1. **I. suffruticosum,** *Ging.* Viola suffruticosa, *Willd.*; Tandi sol, bir suraj mukhi, *S.*; Ratanpuras, *H.*; Nunbora, *Beng.*

A diffuse perennial with often woody branches, alternate subsessile lanceolate leaves, subulate stipules and solitary rose-coloured flowers.

Throughout the province. Common in open pastures and waysides.
Fls. chiefly in c.s.

Usually pubescent. L. linear to oblanceolate, serrate or nearly entire, ·7–1″ long Capsule ·12″, with ellipsoid striate seeds.

FAM. 13. BIXACEÆ.

Trees or shrubs with mucilage canals in the bark (and other places), palminerved or palmately-lobed large leaves with usually minute caducous stipules, and usually large flowers which are panicled, regular and 2-sexual. Sepals 4–5, free, hypogynous, imbricate. Petals 4–5, free, large and coloured. Stamens many. Anthers 2-celled, opening by short slits or pores. Ovary 1-celled, with parietal placentas, or, by the intrusion of the placentas, more than 1-celled (2–5). Ovules many, anatropous. Style slender with simple or lobed stigma. Fruit a 1–5-celled capsule opening by 2–5 valves, the thin dry inner layer of the pericarp separating from and sometimes dehiscing on different lines from the outer. Seeds many, sometimes with long hairs, sometimes outer layer of the testa ariliform and coloured. Albumen copious. Embryo usually curved with more or less foliaceous cotyledons, which are often palminerved. Germination epigeal.

Anthers straight. Capsule 3–5-valved, seeds cottony.
Tree with palmately-lobed leaves . . . . 1. *Cochlospermum.*
Anthers horseshoe-shaped. Capsule 2-valved, seeds with aril-like testa. Large shrub L. not lobed . . . . . . 2. *Bixa.*

1. COCHLOSPERMUM, *Kunth.*

1. **C. Gossypium,** *DC.* Hupu, *K.*; Hopo, *S.*; Galgal, *H.*; Golgol, *Beng.*; Ganiari, Konto palas, *Or.*; Yellow Silk Cotton Tree.

A small, straight, very soft-wooded tree, with palmately 3–5-lobed leaves, 3–8″ diam., and bearing, when leafless, large handsome yellow flowers, 4–5″ diam., which are succeeded by large pear-shaped pendulous fruits.

Chiefly on dry hills from Shahabad and Gaya southwards; rare in the Santal Parganas and the coastal districts; very common from Chota Nagpur and Sambalpur to Angul.

Fl. Jan.–March. Fr. March–June. Deciduous Nov.–May.

Bark light-coloured, fluted. Blaze deep brown, then streaked brown and white. A deep orange-coloured juice exudes from near the cambium. Wood spongy. L. tomentose beneath when young, shining above. Petioles 2–8″. Stipules linear caducous. Fls. in few flowered terminal panicles. Petals emarginate. Capsules 3–4″ by 2½″, 5-celled at the base. The coriaceous epicarp and papery endocarp dehisce on different lines. Seeds many, ·25″ long, reniform, brown, rough, clothed densely with a deciduous floss. Testa hard. Embryo curved.

The wood immersed in water for about 8 hours and the water strained off, mixed with flour and fried, forms a nutritious food in Sambalpur district (*Mudaliar*). The wood is also used for torches. The gum is known as Hog gum and the silk cotton from the seed is one of those known as Kopok.

2. BIXA, *L.*

1. **B. Orellana,** *L.* Latkan, *H.*, *Beng.*; Gulbas, Sakta, *Or.*; The Arnatto.

A small tree with cordate acuminate leaves, 4–8″ long, glabrous and somewhat shining, with a slender petiole 2–3″. Flowers white or rose, 1–2″ diam., in terminal panicles. Ovary 1-celled. Ovules on 2 parietal placentæ. Capule 1·5″, ovoid, softly echinate.

Fl. July–Sept. Fr. Oct.–Nov.

Native of America; often cultivated and is very ornamental. The pulpy testa of the seed yields the Arnatto dye.

FAM. 14. FLACOURTIACEÆ.*

(Including Samydaceæ).

Trees or shrubs without mucilage or resin canals in the bark, with alternate, usually distichous, penninerved, rarely palminerved leaves, frequently with translucent dots or dashes, or punctate beneath due to resin cells. Stipules usually small and caducous. Flowers small, axillary, or in lateral or terminal cymes or racemes with small bracts, regular, 2-sexual, monœcious or diœcious. Sepals 4–several, free, hypogynous or more or less perigynous, sometimes connate in bud and irregularly splitting. Petals present or 0, as many as or 2–3 times as many as the sepals or indefinite. Torus often concave and with variously formed glandular or scale-like or staminode-like appendages, which may be outside, inside, or between the stamens. Stamens more numerous than the petals, 1–many-seriate or in bundles opposite the petals, rarely as many as the petals and then alternating with the sepals. Anthers usually with lateral slits. Ovary sometimes half-inferior, rarely inferior, 1-celled, with 2–8 (usually 3–5) parietal placentas, which sometimes meet in the axis, making the ovary several-celled. Ovules usually many, anatropous. Styles as many as the placentas or more or less connate. Fruit capsular or baccate or with pyrenes. Seeds 1 or more. Testa sometimes with an ariliform outer layer. Albumen present. Embryo straight with generally foliaceous cotyledons. Germination epigeal.

A. Petals present and persistent.
  Unarmed small tree with panicled inflorescence . . . 1. *Homalium.*
B. Petals 0.
  1. Stamens hypogynous, numerous, or flowers 1-sexual.
    Ovary incompletely 2–6-celled, styles as many . . . 2. *Flacourtia.*†
    Ovary 1-celled, styles usually connate . . . . . 3. *Xylosma.*
  2. Stamens perigynous (sometimes nearly hypogynous), 6–15,
    fls. 2-sexual. Ovary 1-celled . . . . 4. *Casearia.*

1. HOMALIUM, *Jacq.*

1. **H. nepalense,** *Benth.*

A small tree, 30–40 ft., with coarsely serrate, prominently nerved leaves, attaining 6·5 by 3–4″, and axillary panicles of small white flowers, ·2–·25″ diam.

Rocky hill jungles, but usually near valleys. Singbhum and Poranat, rare! Karo Block, Keonjhar, *Grieve*; Puri (see var.)! Angul (see var.)! Bonai, *Cooper*! Mayurbhanj, ascending to top of Meghasani, 3800 ft.! Fl. May–June.

Bark light coloured. Young twigs puberulous. L. in ridge specimens only 3″, elliptic or elliptic-ovate, sometimes crenate-serrate, each tooth with a gland at the end of the nerve, acuminate, nearly glabrous, narrowed into the ·5–1″ petiole. Secondary nerves 6–8, 1–2 from near the base. Panicles 2–5″, dense, pyramidal, pubescent. Pedicels ·05–·06″. Fls. densely hairy. Calyx tube funnel-shaped. Sepals 6–8, spreading, linear. Petals as many, linear-oblong, valvate, perigynous. Stamens as many, and inserted with and opposite to the petals, alternating with

---

* The Samydaceæ are closely allied to the Turneraceæ and other families placed at a considerable distance from the Bixaceæ merely on account of their *markedly* perigynous or epigynous ovary. *Vide* Introduction (Classification).

† The characters separating *Flacourtia* and *Xylosma* are not very good ones, and some species show a transition.

fleshy glands. Anther lobes very short. Ovary half inferior, hairy inside and out. Styles 3–5. Ovules about 6, parietal, anatropous. Fr. not seen.

Var. α. L. 2·5–5″, ovate, acuminate, crenate-serrate. Fls. very small, only ·12″ diam., woolly. Top of the Khandabolo Ridge, 3100 ft., Puri!

Var. β. Twigs pubescent. L. 3-6″, ovate-elliptic or broadly elliptic, minutely pubescent, margins crenate eglandular or glands inconspicuous. Bolong Block; Angul!

2. FLACOURTIA, *Commers.*

Trees or shrubs, usually thorny. Leaves toothed or crenate. Flowers small, usually diœcious. Sepals small, imbricate. Petals 0. Stamens many, anthers versatile. Disc lobulate and glandular Ovary imperfectly (rarely perfectly) 2–8-celled, usually with 2–8 deeply intruded placentæ. Ovules 2 superposed on each placenta, styles or stigmas several, and stigmas usually notched. Fruit baccate, with several 1-seeded pyrenes. Germination epigeal, cotyledons sometimes palmi-nerved.

I. L. nearly always under 4″, orbicular to oblong-obovate, never acuminate.
  Shrub with thorns, often longer than the L. and bearing fls. L. 1–2.″ Fls. sub-solitary or racemes few flowered . . . 1. *sepiaria*.
  Small tree with thorns, mostly shorter than the L. and never bearing fls. L. 1·5–3·5.″ Fls. in pubescent racemes . . 2. *Ramontchi*.
II. L. mostly over 4″, acute or acuminate. Racemes pubescent. Fr. red.
  L. 3–6″, ovate glabrescent. Petiole ·4–·5″. Fls. in contracted racemes, short-pedicelled . . . . 3. *latifolia*.
  L. 4–7″, elliptic-oblong, pubescent. Petiole ·25″. Fls. in short axillary racemes, long-pedicelled . . . . . 4. *montana*.
III. L. 2–4″, lanceolate, acuminate, and glabrous. Racemes glabrous. Fr. red to purple. . . . . 5. *cataphracta*.

1. **F. sepiaria,** *Roxb.* Sanu Bainchi, *Or.*

A very thorny small bush, with straight sharp thorns, attaining 1·25–2″ long (but see var.), many of them bearing clusters of leaves or flowers and longer than the leaves. Leaves small, ·5–·7″, very rarely 1–3″, in luxuriant plants, usually cuneate obovate, or orbicular and with cordate base, crenate-serrate except at base, often fascicled. Flowers small, usually solitary at the ends of the short shoots.

In the Northern tract common in Purneah! Common in the Orissa scrub jungles, especially on laterite from Balasore southwards. Cuttack! Khandpara! Nilghiri! Balasore! Puri (Maniband, Jaimangal, etc., forests)! Narsingpur!,

Fls. March-April. Fr. April-May. Evergreen.

Much branched, often only 2–3 ft. high, rigid, thorns sometimes branched. Twigs pubescent. L. rarely oblong or oblanceolate, glabrous; secondary nerves 3–4 reticulate between, petiole under ·1–·2″, often pubescent. Fls. diœcious, rarely in imperfect racemes. Female on pedicels ·15–·2″ long. Styles usually 6–7, stigmas 2-lobed. Berry with about 6–7 pyrenes, ·25–·4″ diam. Pyrenes rugose. Testa smooth. Cotyledons broadly orbicular, ·1″, base somewhat cordate; radicle excluded, straight.

Var. **innocua.** Almost unarmed and flowers in short fascicled racemes. Leaves 1–2″. This is easily distinguished from *F. Ramontchi* by the rigid leaves and the very short racemes and pedicels being erect even in fruit.

Waste lands, Puri (Chattarbar). Fr. Dec.

Bark on large bushes grey, slightly flaky. Blaze hard light brown.

2. **F. Ramontchi,** *L'Herit.* Mehrle, *K.*; Merlec, *S.*; Katahi, *H.*; Kakai, *H. Beng.*; Obir, *Beng.*; Kontadhawra, Mamuri, Balibhaincho, Kontaikuli, *Or.*

A tree or shrub, usually thorny, with crenate-serrate usually obtuse or rounded, often olive-green leaves and yellowish-green flowers, ·25″ diam., either clustered or racemed, or some also solitary in the axils of scales or leaves. Pedicels articulate below the middle. Sepals 4–6, pubescent or hirsute, ·06–·08″ in the male, very early disclosing the yellow stamens. Disc-lobes 4–6, rounded, often lobulate. Styles usually 4–6, small capitellate. Ovules 2 superposed in each cell. Fruit a berry ·3″ diam., red.

Very common throughout the province, both in the valleys and on the hills and in second growth forest.

Fls. Dec.–March, chiefly March. Fr. April–May. Deciduous just before flowering; new shoots appear Feb.–March.

Bark nearly smooth. Blaze rather hard, pale brown.

The fruit is very palatable.

Very variable. The following forms occur:

α. *Ramontchi* proper. L. glabrous, 2–3″, elliptic, ovate or oblong, coarsely crenate; racemes slender, nearly or quite glabrous. Chota Nagpur.

β. *sapida, F.B.I.*? Twigs slender reddish pubescent. L. 2·5″ by 1·5″, oblong to obovate, glabrescent; secondary nerves 3–5, petiole ·3″, pubescent, racemes pubescent. Hills, frequent.

γ. *occidentalis, F.B.I.* Similar, but leaves often orbicular and permanently pubescent or tomentose. Chota Nagpur, Bihar.

3. **F. latifolia,** *Cooke.** Syn. F. Ramontchi, var latifolia, *F.B.I.*

A small or moderate-sized tree, attaining 4–5 ft. girth, with few thorns. Leaves 3–6″ long, ovate-lanceolate or ovate, and somewhat tapering at tip, glabrescent. Petiole ·4–·5″, rather slender. Flowers diœcious; males in very small clusters (contracted racemes), usually on leafless branches. Fruit ·6″ diam.

Sameshwar Hills! Singbhum! Gangpur!

Fls. Feb. Fr. March–April.

Bark grey, flaking on old trees. Blaze hard, pale brown, with flow of water. Base of L. usually cuneate. Secondary nerves 5–7, slender, oblique, 1–2 from close to base; tertiaries very reticulate, not at all scalariform as in *F. montana.*

4. **F. montana,** *Grah.*

A small, sometimes thorny tree, with long thorns on bole, and a few on the branches; twigs softly pubescent. Leaves elliptic-oblong, elliptic or somewhat ovate, 4–7″ long, shortly obtusely acuminate, crenate, permanently pubescent on the nerves beneath. Petiole ·25″, pubescent. Flowers diœcious (always ?), in capitate racemes, axillary, and from leafless axils. Fruit brilliant red, ·7″ diam.

Angul, Bolong Block, rare! Fls. Feb. Fr. Oct.

L. usually glabrescent above and on the smaller nerves, but in the Angul tree more or less permanently pubescent. Secondary nerves 6–8, rather strong beneath, one from base. Tertiaries rather straight and regular. Calyx 4–5-partite, lobes pilose-pubescent. Disc fleshy, annular in female.

The fruit is edible.

---

* I am not quite sure whether this is Cooke's *F. latifolia*, as he described it as having fruit only the size of *a pea*!

5. **F. Cataphracta,** *Roxb.* Panialah, *H.*; Paniyara, *Uran*; Beunch, *Beng.*: Baincha, *Or.*

An erect, small tree with the young trunk covered with large decompound thorns many inches long. Leaves oblong to oblong-lanceolate, acuminate, quite glabrous, crenate, serrate. Flowers in glabrous racemes. Fruit purple, ·8–1″ diam. when ripe.

Very common in northern Purneah! Orissa forests: Mayurbhanj! Tamna forest, Puri! Often cultivated.

Fl. June. Fr. Oct.–Jan.

Trunk quite smooth in old trees. Bark pallid. Blaze with chlorophyll, pale brown. L. 2–4″, sometimes ovate-lanceolate, lower ones on the twigs less acuminate, base usually rounded; petiole ·25–·5″. Fls. ·1–·15″ diam. Stigmas 4–6, capitate.

The cultivated fruit is like a small, round plum, with a small annulus at base and remains of the stigmas at the top. Epicarp somewhat coriaceous, endocarp fleshy, with 8–12 pyrenes compressed with sharp edges and about ·25″ diam. Flesh somewhat tart but of agreeable flavour when quite ripe. I have always seen the wild fruit red (not purple), ·5–1″ diam., but it may be often eaten before ripening.

The seed takes nearly one year to germinate. The seedlings and young plants have slender, simple axillary thorns.

Wood said to be uncommonly good in resisting friction, and might be used for block sheaves. *Ham.*

3. XYLOSMA, *Forster.*

Characters of Key. The *F.B.I.* states that there is one short style and a capitate stigma, but the stigmas are sometimes 2–3, and these are sometimes split nearly to the base. The ovary is also imperfectly 2–3-celled in many cases, just as in *Flacourtia.**

1. **X. longifolium,** *Clos.* Suljara, Gara Sul, *Ho.*; Dandal, Katai, *Kharw.*; Katari, *H.*

A small, glabrous tree, often with long thorns when young, with lanceolate, acuminate, shallowly-toothed leaves 3–6″ long, and small, greenish flowers in short axillary compound racemes. A pretty tree in fruit with innumerable deep-red, globose berries, ·25″ diam., on pedicels ·17–·25″ long, articulate near the base.

Ravines and along nalas in Singbhum and Porahat! Kochang, *Gamble*; Palamau, Neterhat! Evergreen jungles, Mals of Puri!

Fl. Nov.–Dec. Fr. March–April. Evergreen, renews leaves Nov.

L. (somewhat elliptic in the Puri specimen) narrowed both ends, with 6–8 pairs oblique secondary nerves; young somewhat gland-serrate. Petiole ·25–·3″. Male racemes dense, ·3–1″ compound; Fls. with 10 fleshy red disc glands and about 26 stamens. Bracts linear-oblong (ovate-acuminate, *F.B.I.*). Stigmas 2–3, small, capitate (or 1 capitate, *F.B.I.*). Ovules few parietal. Berry 1-celled, with coriaceous pericarp and 3–6 angled seeds, seated, on the persistent calyx and disc.

4. CASEARIA, *Jacq.*

Trees or shrubs. Leaves distichous, often with dots or translucent dashes. Pedicels short, jointed. Calyx inferior, deeply 4–5-lobed; persistent. Stamens 6–10, united into a tube, with small petaloid staminodes or nearly free, hypogynous or sub-perigynous. Anthers introrse. Stigma capitate or 3-lobed. Capsule succulent, ellipsoid. Seeds many, with a fleshy, usually scarlet aril and straight embryo.

L. oblong, more or less tomentose . . . . 1. *tomentosa.*
L. elliptic, glabrous . . . . 2. *graveolens.*

* As noted in the *C. N. Flora*, p. 160. The two genera are scarcely separable.

1. **C. tomentosa,** *Roxb.* Rore, *K.*; Chorcho, *S.*; Churchu, *H.*; Beri, *Kharw.*; Maun, *Beng.*; Tondri, *Gond.*; Der, *Th.*; Benimanj, Kokra, *Or.*

A small tree, or flowering as a shrub, with pubescent or tomentose twigs. L. oblong, or the smaller ones somewhat ovate or elliptic, pubescent, especially on the ribs beneath. Flowers axillary on the new shoots, ·25″ diam., green. Capsules soft green, axillary, and from leafless axils oblong 6-angular.

Throughout the Province. Frequent in North Champaran! Very common in waste ground and river valleys in Chota Nagpur! Common on laterite in scrub jungles from Khandpara to Puri, and on cotton and other soils in Angul!

Fl. March–May. Fr. April–May. Sub-deciduous Feb.–March. L. turn red before falling.

L. from 2″ at base of twigs to 7″ by 2″, obtuse entire or crenate. Stipules caducous, petioles ·3–·5″. Sepals usually 5. Stamens 6–10, alternating with fleshy pubescent staminodes; tube short. Fr. ·75–1·25″. Seeds with a scarlet aril. There are often 2–3 cymes together on peduncles ·3″ long.

The fruits, pounded with mud, are thrown into dammed-up streams for killing fish. Campbell says that the pounded bark is applied externally in dropsy, fever, and snake-bite.

2. **C. graveolens**, *Dalz.* Reri, *K.*; Nuri, *S.*; Chilla, *H.*; Benchu (in *Kodarma*); Kokra, Beni man and Jamurdhi (in *Sambalpur*), *Or.*

A small tree with elliptic or elliptic-oblong or -ovate glabrous leaves. Flowers greenish, in dense clusters from the leafless axils. Fruits broadly ellipsoid or broadly oblong, ·65–1″ long, yellow.

Also distributed throughout the whole province from Northern Champaran to Sambalpur and Puri. More of a high level plant than *C. tomentosa*, but frequent in valleys. Ascends to nearly 3000 ft. in Palamau.

Fl. May–June. Fr. May–July. The tree is nearly or quite leafless at the time of flowering, the new L. appear on the barren branches about the same time, but not till later on the flowering branches. Old L. turn copper-coloured in Dec. and Jan.

Twigs glabrous. L. 4–8″ by 2–3·5″, with often smaller ones at base of the twig. Very shortly acuminate, entire or crenate, usually rounded at the base. Petiole ·25–·5″. Sepals 5, gland dotted. Stamens 6–8, alternating with linear-oblong villous staminodes.

FAM. 15. PITTOSPORACEÆ.

1. PITTOSPORUM, *Banks.*

Trees or shrubs, sometimes epiphytic. Leaves alternate or subverticillate, entire and exstipulate. Flowers terminal or axillary. Sepals 5, imbricate. Petals 5, hypogynous imbricate, erect, with connivent or connate claws. Torus small. Stamens 5, erect, anthers versatile, 2-celled, introrse. Ovary incompletely 2–3-celled by the projection of the parietal placentæ, not on a gynophore. Style simple, stigma terminal, 2–3-lobed. Ovules 2–more on each placenta. Fruit capsular, 1-celled, 2–3-valved, with the valves placentiferous in the middle. Seeds smooth, imbedded in pulp, with copious rather leathery albumen.

1. **P. floribundum,** *W. & A.* Bagh-muta, *Kharw., Kisan.*

A small tree up to 25 ft. with branches and leaves often subverticillate. Leaves oblong to lanceolate or oblanceolate, shortly

petioled, shining above. Flowers small, yellow, numerous, in sub-corymbose fascicles. Capsule globose, 2-valved, 3-4-seeded. Seeds surrounded by viscid juice, with red testa.

Higher hills of Ranchi and Palamau on rocky ground, often epiphytic on rocks and in the hollows of other trees. Common along ravines at Neterhat, 2-3000 ft.! Horhap Forest, common! Ranchi Ghats (Adar)!

Fls. June-July. Fr. Oct. Evergreen.

Bark smooth, lenticillate, slightly peeling. Blaze white, a very white layer between wood and outer bark. L. 4·5-7″, or on flowering branches only 2·5-4·5″, acute or acuminate, rarely obtuse, tapering at base into a slender ·2″ long petiole; margins often undulate. Secondary nerves 7-8, fine, very finely reticulate between. Panicle branches and slender pedicels articulate. Capsule rugose when dry, slightly appressed brown-hairy, ·2-·3″ diam., slightly 4-grooved; inside of carpels horizontally striate. Seeds attached to mid-rib of carpels near the base, oblong, flat on two faces.

FAM. 16. POLYGALACEÆ.

Usually herbs, sometimes shrubs or rarely small trees (*non regionis nostræ*). Leaves alternate or rarely opposite, or whorled, simple entire, exstipulate. Flowers irregular, bracteate, axillary, or spicate or racemed. Sepals 5, free, imbricate, 2 inner (*wings*) often petaloid and larger. Petals 5 or 3, the anterior (keel) usually different and carinate. Stamens 4-5 or usually 8, hypogynous, monadelphous, rarely distinct, anthers opening by pores. Ovary free, 1-3-celled. Ovules 1 or more, anatropous. Fruit usually 2-celled and 2-seeded and loculicidal. Seeds usually strophiolate and albuminous.

Two inner sepals (wings) larger. Stamens 8 . . . . . . 1. *Polygala.*
All sepals petaloid, subequal. Stamens 4-5 . . . . . 2. *Salomonia.*

1. POLYGALA, *L.*

Herbs, rarely shrubs, with alternate leaves and racemose, irregular papilionaceous flowers, with the "wings" formed of the two inner, larger, usually petaloid and persistent sepals. Petals 3, united at the base with the staminal tube, inferior, tubular or keel-shaped and generally crested. Stamens 8, filaments united for their lower half into a split tube or sheath; anthers opening by pores. Ovary 2-celled; ovules 1 in each cell, pendulous. Capsule 2-celled, loculicidal, 2-seeded. Seeds usually strophiolate and albuminous.

The L. in this genus are often exceedingly variable in one and the same species.

I. Shrubby. Fls. not yellow. Wings often scarcely petaloid.
  Bracts persistent. Wings obovate . . . . . . 6. *crotalarioides.*
  Bracts caducous. Wings hatchet-shaped . . . . 1. *glomerata.*
II. Herbaceous. Bracts persistent or sub-persistent. Keel crested.
  A. Wings not petaloid, oblique or falcate. Strophiole 3-toothed
    Racemes short and dense, wings very oblique . . 2. *chinensis.*
    Racemes longer than the L., lax . . . . . 3. *elongata.*
  B. Wings petaloid. Strophiole not toothed.
    Racemes long, but dense, terminal and axillary . . 4. *leptalea.*
    Racemes very short, lateral, or flowers sub-solitary . 5. *eriopteru.*
  C. Wings usually petaloid, not oblique. Strophiole 3-fid.
    Racemes rather short, axillary very dense . . . 6. *crotalarioides.*
III. Small herb. Flowers yellow. Keel hooded, not crested.
  Racemes terminal . . . . 7. *triphylla.*

1. **P. glomerata,** *Lour.*

A twiggy undershrub, 1–2 ft. high, with pubescent branches, ovate or ovate-lanceolate, sub-distichous leaves 1–1·75″ long, rarely attaining 2 by ·3–·75″, and greenish inconspicuous flowers in extra axillary racemes ·3–·5″ long. Wings ·2″ by ·1″, oblique, falcately-oblong, apiculate with scarious margins, nearly ·25″ in fruit, ciliate.

Singbhum valleys in the Latua Forest under shade, very rare, but locally abundant! Bandgaon, *C. B. Clarke*! Fls. Oct.–Jan. Fr. Jan.–Feb. Deciduous in the h.s.

Distribution: Sikkim, Khasia, Assam, Chittagong, Burma and Java.

L. sometimes (outside our area) oblong or elliptic-oblong or broadly lanceolate; ciliate and somewhat hairy both sides, acute with rounded base and 3-5 fine, rather obscure secondary nerves. Petiole pubescent, ·1″ Racemes pubescent, close-flowered, with very caducous bracts. Corolla white or upper portion purple, keel sub-saccate, ·15″, with small fimbriate crest. Petals oblong with small scale near base. Ovary sub-didymous and capsule ciliate. Seeds oval, silky, with 3-lobed strophiole.

2. **P. chinensis,** *L.* Syn. P. arvensis, *Willd.* Gaighura, *S.*

A herb with a slender or woody rootstock, stems hairy with curled hairs, and excessively variable leaves. Flowers sub-solitary or in many very short, lateral racemes, rarely exceeding ·5″, but sometimes proliferous. Bracts minute persistent acuminate. Wing-sepals herbaceous, ·2″, *very oblique,* acuminate, rather exceeding the broadly oblong, oblique-tipped, margined and ciliate capsule.

Rather frequent in open scrub jungles and grassy ground. Chota Nagpur, Singbhum! Manbhum! Palamau! Sambalpur! It extends to Bhotan and United Provinces on north, Dacca on east, and Madras on south, and occurs therefore probably throughout the Province.

Fls., Fr. July–Dec.

Branches usually procumbent, 4–12″. L. from ·3–2·5″, orbicular, elliptic, obovate, oblanceolate or linear; the longer forms are usually narrow, generally ciliate, with small curled hairs; petiole minute. Fls. green, or "when young, yellow fading to pink" (*C. B. Clarke*). Wings usually straight on upper side, rounded on lower side, tapering at base. Capsule sometimes scarcely notched, margined, ciliate. Seeds ellipsoid, hirsute, and with hard, white, 3-toothed strophiole. Lateral teeth often longer than median.

The root is given in fever. *Campbell.*

3. **P. elongata,** *Klein.*

A herb somewhat resembling *P. erioptera,* 6–15″ high, usually branched from the root. Stems with a curly pubescence or glabrous. Leaves ·5–2·2″, scarcely petioled, linear or linear-oblong with tapering base. Flowers yellow, in elongate lateral often lax racemes attaining 3–4″. Wings ·2–·22″, herbaceous, somewhat oblique, 5-nerved and usually apiculate. Capsule glabrous, very oblique at the usually retuse or notched top.

Behar, *Kurz*!

4. **P. leptalea,** *DC.*

A very slender, erect herb, sometimes from a woody stock but flowering its first year, 9–18″ high, simple or branched with angled stems and linear leaves, ·5–1″, narrowed both ends. Racemes dense, terminal and axillary elongate, with small pink flowers ·12–·14″ long. Wings petaloid, 3-nerved, narrowly obovoid, nearly symmetrical.

Capsule oblong-obovoid, retuse and somewhat oblique above, margined, nearly as long as wings. Seeds densely hairy, strophiole galeate.

Chota Nagpur, very common on clay soils in thin jungle! Common at Neterhat, 3000 ft.! Santal Parganas! Orissa, on the hills!
Fls., Fr. Sept.-Dec.

5. **P. erioptera,** *DC.*

A herb with many sub-erect or diffuse pubescent branches from an often stout root, linear, linear-oblong or more rarely elliptic, leaves ·3-1·2″ long and yellow flowers, ·17-·2″ long, with densely pubescent, elliptic, obovate wings in very few-flowered short racemes. Capsule oblong, pubescent, not at all winged.

Behar, *J.D.H.*! Darbhanga! Daltonganj, *Gamble*! Mayurbhanj, *Hooper*!
Fls. Aug.-March.
The whole plant is usually very pubescent and the leaves variable, but the B. & O. specimens seen have all narrow L. *The Flora of Madras* describes the "wing-petals" as triangular and falcate.

6. **P. crotalarioides,** *Ham.* Bijnori, *Gond*; Gaighura, Lilkathi, *S.*

A small shrub, or in var. *glaucescens*, herbaceous, from a woody stock. Stems and branches with spreading hairs, 6″ to 2 ft. long. Leaves obovate or ob-lanceolate, 1-3·5″, hairy, rounded or obtuse, scarcely petioled. Racemes ·4-1·25″, dense, with minute hairy subulate bracts and bracteoles, which persist long after the fruit has fallen. Flowers ·25-·3″ long, lilac or white with purple tips, pedicel not exceeding the bract. Wings obovate, ciliate, rounded. Capsule half as long, orbicular margined, retuse, ciliate. Seeds dark brown, hairy. Strophiole thin, deeply 3-fid. Lateral segments oblong or obovate, rather shorter than the central.

Ramnagar Hills, in open forest on sandstone, very shrubby!
Fls., Fr. May-Sept.

Var. **glabrescens.**

Shoots herbaceous, 3-8″, all parts much less hairy. Leaves more glaucous and glabrous on both surfaces, but ciliate. Bracteoles smaller.

Chota Nagpur!
L. lanceolate-obovate or oblong-obovate, somewhat shining beneath, 1·5-3·5″. Fls. greenish or pink, wings ovate or ellipsoid, sub-petaloid with green veins, lateral petals oblong, curved, pinkish.
This has been confused with *P. chinensis* owing to the description of the strophiole in the *F.B.I.* being described as 2-appendiculate and that of *P. chinensis* as with 3 appendages. The *Bijnori* of the Central Provinces is this species. Its rootstocks are ·12-·3″ diam., brown and wrinkled when dry, in which form they are sold in bazaars. A preparation is given for cough (*Camp.*), and it is used (*fide Haslett*) in the Santal Parganas in he preparation of country spirit.

7. **P. triphylla,** *Ham.*

A small herb with simple or branched stems 2-6″, rarely 10″ high, bearing generally a crown of approximate, membranous, elliptic, orbicular, ovate or spathulate leaves, ·5-2″ long, and terminal racemes 1-3″ long of small clear yellow flowers, fading pink. Seeds strophiolate.

Damp banks and rocks. Common in Chota Nagpur! Very common on Parasnath!
Fls., Fr. Sept.-Jan.

In the more branched forms the L. are more scattered, 5-6-nerved and acute, in simpler forms rounder and obtuse and fewer-nerved, in all ciliolate and sometimes with minute hairs on surface. Calyx wings petaloid, deciduous in fruit. Keel hooded, not crested. The seeds are black and usually pubescent.

2. SALOMONIA, *Lour.*

Flowers minute, in terminal spikes. Sepals nearly equal, the two inner somewhat larger, all petaloid. Petals 3, not crested. Stamens 4–5, monadelphous below.

1. **S. oblongifolia,** *DC.*

A little herb, often quite simple, 3–8″ high, with small sessile, linear-oblong to elliptic or ovate-lanceolate leaves, ·1–·3″ long, and dense spikes of minute pink flowers ·08″ long.

Common in damp places! Fls., Fr. most times of year.

FAM. 17. CARYOPHYLLACEÆ.

Usually herbs with opposite branches generally jointed or thickened at the nodes. Leaves opposite, entire or serrulate. Stipules scarious or 0. Flowers small or moderate sized. Sepals 4–5, free or connate, imbricate. Petals 4–5 or 0, rarely perigynous. Stamens 10 or sometimes fewer, inserted with the petals on a hypogynous short disc or gonophore, or sometimes on a perigynous ring. Anthers 2-celled with longitudinal dehiscence. Disc sometimes of glands. Ovary free, 1-celled or imperfectly 3–5-celled, styles 2–5 or connate. Ovules 2–many on slender basal funicles, or funicles united into a column, amphitropous. Fruit capsular, often with thin walls, valves of teeth or splitting more or less to the base. Seeds often reniform; hilum marginal or central, albuminous. Embryo usually curved round the albumen, or nearly straight; cotyledons narrow, incumbent.

1. Sepals connate into a tube. Fls. moderate sized . . . . 1. *Saponaria.*
2. Sepals free or nearly so. Fls. small.
   a. Stipules 0. Styles free.
      Petals 2-fid or 2-lobed or 0 . . . . 2. *Stellaria.*
      Petals entire . . . . 3. *Spergula.*
   b. Stipules scarious. Style 2–3-fid.
      Diffuse. Petals 2-fid . . . . 4. *Drymaria.*
      Diffuse. Petals entire . . . . 5. *Polycarpon.*
      Erect. Petals entire . . . . 6. *Polycarpæa.*

1. SAPONARIA, *L.* Soapwort.

Herbs. Flowers moderate sized, terminal on the dichotomously branched inflorescence with a tubular 5-toothed or -lobed calyx and 5 clawed petals. Stamens 10. Ovary 1- or imperfectly 2–3-celled. Ovules many. Fruit capsular, 4-toothed.

1. **S. vaccaria,** *L.* Syn. S. perfoliata, *Roxb.*; Tilothi, *Vern.*; Sabuni, *Beng.*; Musna, *H.*, *S.*

Erect, 1–3 ft., branched above with cauline leaves, narrow, lanceolate to linear-oblong, amplexicaul, glabrous, and 2–3-chotomous panicles of pink flowers on erect ·7–2″ long pedicels.

Northern tract, frequent in cultivated fields. Bihar, *J.D.H.*! Champaran! Fls., Fr. Jan.–March.

Calyx ·3″ to ·5″ in Fr. Sepals keeled. Petals obovate. Capsule included in calyx, ovoid. Seeds large, globose, black, granulate. Campbell says it is cultivated for its oil in Manbhum.

2. STELLARIA, *L.*

Herbs with white flowers, often small, in 2-chotomous or 2-chasial cymes, or solitary between the forks of the 2-chotomous branches. Sepals free, or connate at the base only. Petals usually 5, 2-fid or 2-partite or sometimes 0. Stamens 10 or fewer, hypogynous or sub-perigynous. Ovary 1-, rarely 3-celled. Styles 2–3, rarely more. Capsule short, splitting into as many entire or 2-fid valves as there are styles. Seeds compressed. Embryo annular.

Petals 0 or 5, 2-fid to base. L. ovate, upper sessile . . . 1. *media.*
Petals 4, long-clawed, emarginate or 2-lobed. L. petioled . . 2. *Wallichiana.*

1. **S. media,** *L.* Chickweed.

A small diffuse herb with a line of hairs on the branches and inflorescence often glandular, rather flaccid ovate leaves ·5–1″ long with rounded rarely sub-cordate base, lower long-petioled, upper sessile elliptic. Flowers ·25–·3″ diam. Petals 5, 2-fid to base or absent. Stamens 3, 5 or 10. Capsule ovoid-cylindric, longer than the sepals. Seeds brown, obtusely tubercled.

Champaran! Fls., Fr. c.s.
The common little European weed.

2. **S. Wallichiana,** *Haines in Kew Bulletin,* 1920, 2. Syn. Alsinella Wallichiana, *Benth.*, Wall. Cat., No. 630; S. media, *F.B.I.* (in part).

Habit similar; gland hairs both in and outside of the lines of pubescence on the branches. Leaves ·5–·8″ with broadly sub-cordate base, but cuneate on the petiole and all leaves petioled. Flowers ·2–·25″, usually 4-merous. Petals long-clawed, often only emarginate or 2-lobed, sometimes 2-fid. Stamens 8. Capsule not exceeding the sepals. Seed acutely tubercled.

Purneah, in damp localities under shade! Similar specimens were collected by Clarke in Rungpore! Fls., Fr. Dec.–Jan.

3. SPERGULA, *L.* Spurrey.

Herbs with opposite leaves and often abbreviated branchlets in the leaf axils, so that the leaves appear to be whorled or fascicled. Stipules small, scarious. Flowers in panicled cymes. Petals entire. Stamens 5 or 10 on a perigynous disc. Ovary 1-celled, styles 3 or 5. Capsule with 3–5 entire valves. Seeds compressed.

1. **S. arvensis,** *L.*

A small, pubescent or glandular, diffuse green herb with linear-subulate, semi-terete, rather fleshy leaves and white flowers ·2–·25″ diam., petals obtuse. Seeds papillose, keeled or narrowly winged. The fruiting pedicels are deflexed.

Rare, in cultivated ground in the northern tract. Also Chota Nagpur (*Bengal Plants*, but I have seen no specimens). Fls., Fr. c.s. It is a common weed in English cornfields.

2. **S. pentandra,** *L.*

A herb very similar to the last, but glaucous and with terete leaves, petals lanceolate, acute. Seeds smooth, broadly winged.

Occasional in cultivated ground and rather more common in northern India than the last. Chota Nagpur (*Prain*, but I can find no specimens).

4. DRYMARIA, *Willd.*

Diffuse herbs with opposite leaves and small, often fugacious or bristly stipules. Sepals 5, herbaceous. Petals 5, 2–6-fid. Stamens 3–5, slightly perigynous. Ovary 1-celled. Style 2–3-fid. Capsule 2–3-valved. Seeds usually few.

1. **D. cordata,** *Willd.*

A herb with long, slender base or creeping and rooting branches, often 1 ft. long, with distant pairs of orbicular-ovate leaves, ·3–·8″ long, 3–5-nerved from the base. Inflorescence sometimes glandular-pubescent, panicle branches very slender. Flowers very small. Sepals with membranous margins. Petals very small, 2-fid to middle. Capsule 2–3-valved, with 1–2 brown, reniform, compressed seeds.

Parasnath! Fls. Aug.–Sept. Fr. Nov.–Dec.

5. POLYCARPON, *L.*

Diffuse herbs with opposite and pseudo-whorled leaves and scarious stipules. Flowers small and inconspicuous, in crowded, many flowered cymes, with scarious bracts or solitary in the forks of the branches. Sepals 5. Petals 5, small or 0, white or hyaline, entire or toothed. Stamens 3–5. Ovary 1-celled, style short, 3-fid.

1. **P. Lœflingiæ,** *Benth.*

A prostrate, much 2-chotomously branched weed with hairy or pubescent (or glabrous, *F.B.I.*) branches 3–9″ long, and small, pseudo-whorled, narrow, oblong, oblanceolate or spathulate leaves, ·15–·6″. Flowers in crowded cymes, with silvery bracts and sessile in the forks. Petals shorter than the obtusely-keeled sepals, white, linear, delicate, inserted, with the delicate stamens in a slightly perigynous ring; sometimes petals absent. Seeds minute, brown, numerous.

Very common in old rice-fields and damp edges of ponds throughout the province. Singbhum! Purneah! etc. Fl., Fr. Nov.–May.

The sepals are ·1″ long, with scarious margins, and somewhat boat-shaped in fruit.

6. POLYCARPÆA, *Lamk.*

Usually erect herbs. Leaves opposite, sometimes pseudo-whorled, stipules scarious. Flowers in cymes. Sepals 5, free, scarious, and

often coloured. Petals 5, entire, 2-toothed or erose. Stamens 5, hypogynous or subperigynous, sometimes cohering and adnate to petals. Ovary 1-celled. Style slender, 3-fid or 3-toothed. Capsule 3-valved.

1. **P. corymbosa,** *Lamk.*

A much-branched herb, 3–6″, very rarely 12″ high, with very slender, tomentose, erect branches, opposite linear leaves, and terminal, silvery, panicled, dense, dichotomous cymes of very small flowers.

Rocky places. Behar, near the Sone, *J.D.H.*! Chota Nagpur, frequent! Puri! Fls. Aug.–Nov.

Rootstock woody, L. ·3–·5″, sometimes pseudo-whorled from the axillary leaf fascicles. Sepals lanceolate, very acute, ·05–·08″, brown and shining or silvery in fruit. Petals minute, red, entire free. Ovary sometimes only 4-ovuled. Capsule oblong, ·04″.

FAM. 18. PORTULACACEÆ.

Herbs, rarely undershrubs. Leaves opposite or alternate, entire, with scarious or bristly stipules, rarely stipules absent. Flowers regular, 2-sexual. Sepals (bracts?) 2, free or somewhat connate at base. Petals 4–6, very caducous. Stamens as many as the petals and opposite to them, or fewer through abortion, or very many in one or two whorls. Ovary superior or sunk somewhat in the torus, 1-celled, with 2–8-partite style. Ovules 2–∞, campylotropous on a basal central placenta. Fruit capsular, opening by valves or circumsciss, usually many-seeded. Embryo more or less curved round the albumen or nearly straight.

1. PORTULACA, *L.*

Often rather fleshy herbs. Anterior sepal larger than the posterior. Petals free or somewhat connate. Stamens 4–many. Ovules numerous on the often 3–8-branched central placenta. Capsule circumsciss.

Rootstock thick, L. terete linear . . . . 1. *tuberosa.*
Root annual, L. not terete.
  L. ·25–1·5″, with cuneate base, wider above . . . . . . 2. *oleracea.*
  L. ·2–·3″, ovate-oblong to ovate-lanceolate . . . . . . 3. *quadrifida.*

1. **P. tuberosa,** *Roxb.*

A herb with numerous branches, 2–3″ long, spreading from a thick fusiform root. Leaves sessile, linear, terete, fleshy, ·5″, with midrib decurrent on the stem and with tufted brown hairs at the nodes. Flowers yellow, in small terminal clusters, surrounded by about 8 leaves and tufted hairs. Fruit sessile, shining, ·2–·25″, ovoid, girt not quite half way up by the torus and calyx. Seeds minutely tuberculate.

Monghyr, *Hamilton* (*F.B.I.*) Fls., Fr. July, Oct.
It is entered in Camp. and Watts' Catalogue without remark.

2. **P. oleracea,** *L.* Dali ara, *K.*; Mota uric' alang, *S.*; Bara laniya, *Vern.*

A prostrate or erect, subsucculent herb, 6–12″, with cuneate-oblong or cuneate-obovate, usually truncate leaves, ·25–1·5″ long, whorled above, stipular hairs scarious, minute, or absent. Flowers yellow, sessile, solitary, or in clusters or cymes, supported by the whorl of leaves. Stamens 8–12.

Very common in open ground. Fls., Fr. r.s.
Is largely used as a pot-herb.

3. **P. quadrifida,** *L.* Suni ara, *K.*; Chota laniya, *Vern.*

A prostate, creeping and rooting, sub-succulent herb, with numerous ascending branches, small, fleshy, narrowly elliptic or ovate or ovate-lanceolate opposite leaves, ·2–·3″, with very short petioles and bristly stipules. Flowers solitary, terminal, yellow. Sepals hyaline, united at base. Petals 4, oblong, united below. Stamens 8–12, filaments hairy at base. Style long, 3–4-cleft.

Common everywhere in open places. Fls., Fr. r.s.
The flowers only open in bright sunshine like others of the genus. This is also used as a pot-herb.

4. **P. grandiflora** (the Sun Plant), is the beautiful little Brazilian species so often cultivated.

Campbell and Watts (Catalogue) describe a plant with 10 perfect stamens, which they say appears to be the cultivated plant gone wild, and is a troublesome weed on footpaths and roadsides in many parts of Chutia Nagpur. L. thick, fleshy, pale green, with dark green reticulations. Fls. pale purple, ·25–·5″ diameter. Stem and flowering heads covered with long woolly hairs, especially at the nodes.

FAM. 19. AIZOACEÆ (Ficoideæ).

Herbs or undershrubs with simple, sometimes fleshy, opposite, alternate or pseudo-verticillate leaves with scarious or 0 stipules. Flowers from small and greenish to large and showy (but not in our area), in cymes or clusters, rarely solitary, 2-sexual, rarely polygamous, usually homoiochlamydeous, 4–5-merous, or stamens fewer or more or less numerous, free or in bundles, or with filaments more or less connate in a ring below, hypogynous or perigynous, outer sometimes petaloid or converted into staminodes. Ovary free (in our species), 2–5-celled, with styles as many as the carpels. Ovules many, axile, or 1 basal, in each carpel. Fruit usually capsular, sometimes circumsciss or separating into cocci. Seeds many or 1 in each carpel, usually reniform, compressed; embryo curved or annular, surrounding the mealy albumen, radicle next the hilum. In *Mollugo* there is sometimes a very curious tail-like appendage to the hilum.

Stamens hypogynous. Capsule 3–5-celled, loculicidal . . . 1. *Mollugo.*
Stamens perigynous. Capsule 1–2-celled, circumsciss . . . 2. *Trianthema.*

1. MOLLUGO, *L.*

Branched herbs, sometimes dichotomous and prostrate, with pseudo-whorled or alternate entire leaves and fugacious stipules. Flowers

small, clustered, or cymose, axillary. Tepals 5. Stamens 5–3, rarely many, hypogynous, staminodes sometimes present. Ovary 3–5-celled, styles 3–5. Ovules many, axile. Capsule membranous, included in the perianth, loculicidal. Seeds several, rarely 1 in each cell, often with a delicate appendage.

A. Erect or sub-erect. Fls. in slender cymes . . . . . . 1. *stricta.*
B. Prostrate. Fls. in axillary dense cymes or clusters.
  Glabrous or nearly so. Fls. pedicelled . . . . . . 2. *spergula.*
  Woolly or hairy. Fls. sessile or very shortly pedicelled . . . 3. *hirta.*

1. **M. stricta,** *L.* Syn. M. pentaphylla, *L.*

A slender small herb, 3–10″ high, with grooved or angled, usually much-branched erect stems and opposite, fascicled or pseudo-whorled leaves, ·5–1·7″ long. Flowers minute, greenish or white, in slender, dichasial panicles, or in uniparous scorpioid cymes on the branches of a dichasial panicle. Capsule oblong, slightly 3-sided, loculicidally 3-valved. Seeds several, bright chestnut, covered with close, very minute blunt spines or warts. Hilum minutely appendaged.

On bare walks, cultivated and waste ground, common in all districts (among rocks at Ranchi, *Carter*), frequent at Neterhat (3000 ft.). Fls., Fr. all the year round (but not the same plant).

L. sub-sessile, glabrous, sometimes rather fleshy, shining, linear-oblong to obovate, apiculate. Stipules minute, scarious. Sepals connate at base or free imbricate. ·07″ elliptic-oblong, obtuse. Stamens 3–5, very small, connate at base. Embryo curled.

2. **M. spergula,** *L.* Syn. M. oppositifolia, *L.* (teste *Flora of Madras*).

A small, diffuse or prostrate plant, with branches from the root up to 1 ft. long, pseudo-whorls of leaves, more rarely opposite, and long-pedicelled, greenish or white flowers, 1–several, axillary. Capsule ellipsoid, shorter than the sepals. Seeds many, covered with very close minute warts or points, as in the last, and with a minute subulate bristle with sometimes a second yet more minute bristle.

Darbhanga! Manbhum, near Raniganj (which is just outside our area) in sandy soil round tanks, *Kurz*! Puri, in sand! Perhaps common in other districts, but the fls. are inconspicuous. Fls., Fr. May–July.

Nearly or quite glabrous. L. ·2–1″ long, spathulate, lanceolate, elliptic or obovate, sub-sessile or shortly petioled. Secondary nerves obscure. Pedicels ·12–·5″, often exceeding the L. Sepals ·12–·2″ (·5″, *teste Clarke*), often with scarious margins. Stamens 5–10. Stigmas 3, minute.

In a form found on the seashore, Puri, the branches are papillose on one side, L. only ·15″ long. Styles 3, stout.

3. **M. lotoides,** *O. Kze.* Syn. M. hirta, *Thunb.*

A stellately-tomentose herb, with woody tap-root and numerous procumbent stems 1–3 ft. long, much branched, with orbicular or obovate leaves, ·3–·5″ diam., contracted into a more or less cuneate base and petiole, ·2″, fascicled or pseudo-whorled. Flowers green, with free, persistent sepals, ·2″ long in flower, ·3″ in fruit, stellate-tomentose, oblong-lanceolate or inner boat-shaped, mucronate, one margin scarious. Capsule 5-celled, with very numerous, brown, punctulate seeds.

The seed is remarkable. From the base of the funicle grows up a

membranous jacket, loosely enveloping the funicle and supporting the seed, while the raphe is continued as a whip-like tail curling three-fourths round the seeds.

Usually in sandy places. Manbhum, Campbell! Mahanadi River bed, Angul! Fls., Fr. Feb.-April.

L. sometimes only ·2″ long, but up to 1″. Stamens 5, with long filaments from an annular, very minute hypogynous ring, alternating with ridges on the ovary, which they exceed. Styles short and stigmas 5, linear. The capsule is loculicidally septifragal (first splitting through the loculi, then separating with part of the septa and leaving the axis).

2. TRIANTHEMA, *L.*

Diffuse, prostrate, glabrous or papillose herbs, with opposite, unequal, entire leaves; petioles connected at their base by their dilated membranous margins, exstipulate. Flowers small, axillary, solitary, cymose or clustered, with a short or elongate hypanthium bearing 5 small, often coloured sepals. Stamens 5–10 or more, near the top of the hypanthium, perigynous. Ovary free, 1–2-celled, with 1–2 subulate styles. Ovules 1-many, basal. Capsule membranous or coriaceous, circumsciss, the lid sometimes with 1–2 seeds, the lower portion 2-many-seeded. Embryo annular.

1. **T. monogyna,** *L.* Syn. T. portulacastrum, *L.* (*Flora Madras*) T. obcordate, *Roxb.*; Kecho a:, *K.*

A succulent herb with prostrate forked branches 8–18″ long, opposite or sub-opposite, unequal, broadly obovate, oblong or elliptic leaves, ·5–1″, or attaining 2″ by 1·75″, somewhat lucid beneath and with usually undulate margins. Flowers solitary, sessile, white or pinkish from the forks of the branches. Ovary 1-celled, with several campylotropous ovules on a basal central column sometimes adnate to the side of the ovary. Capsule with a lower scarious or membranous portion and an upper, brown, more coriaceous portion, circumsciss. Seeds black with concentric lines.

A common weed in most districts. Fls., Fr. r.s.

Stems pubescent on one side. L. obtuse or retuse, base obtuse. Base of petiole sheathing with two small stipule-like appendages. Fls. sunk in the forks, sheathed by the base of the petiole. Sepals petaloid, with an excurrent herbaceous centre, ·2″. Stamens 15–24.

The plant is eaten as a pot-herb.

FAM. 20. ELATINACEÆ.

Herbs or undershrubs, sometimes very small or aquatic, with opposite or whorled, simple, stipulate leaves. Flowers small or very small, axillary, solitary or cymose. Sepals and petals 2–5, free, imbricate. Stamens isomerous or diplostemonous, hypogynous, free, with versatile anthers. Ovary with 2–5 cells and styles, stigmas capitate. Ovules ∞, axile, anatropous. Capsule septicidal, separating from the axis and septa or septifragal. Seeds straight or curved, albumen scanty or 0, embryo straight or curved, cotyledons small.

1. BERGIA, *L.*

Erect or prostrate herbs or undershrubs, with opposite or pseudo-whorled, usually serrate leaves. Flowers very small, solitary or fascicled, 3–5-merous. Sepals with green midrib and membranous margins.

Sepals and petals 5. Stamens 10 . . . . 1. *verticillata.*
Sepals and petals 3–5. Stamens 3–5 . . . . 2. *ammanoides.*

1. **B. verticillata,** *Willd.*

A herb with rather succulent, creeping stems, somewhat resembling an *Ammannia*. Leaves elliptic-lanceolate, ·8–1·5″ shallowly serrate with very short petiole. Flowers very small, crowded in the axils of the leaves, sessile, white, with 5 sepals and petals and 10 stamens. Capsule depressed, globose, ·08″ diam.

Plains of India, *Royle* (without locality)! Bengal, occasional, *Prain* (without locality). Rice fields and river banks, Madras! A native of various parts of India in wet places during the rainy season, *Roxb.* It probably occurs in Bihar and Orissa, but has so far not been collected there.

2. **B. ammanoides,** *Roxb.*

A diffuse or erect (*Roxb.*) annual with branches 4–8″ long, lower decumbent, sometimes thinly pubescent. Leaves sub-verticillate (opposite, with abbreviated shoots in their axils), ·3–1″ long, oblong-oblanceolate, minutely sharply serrate, tapering to the sessile base. Flowers very small, crowded, rose-coloured, sepals, petals and stamens 3–5, isomerous.

Bengal, *J.D.H.* (without locality), very probably in Behar! Nuddea, *C.B.C.*! Gangetic Plain! Doubtless in our province. Fls., Fr. Oct.–Jan., and during rains (*Roxb.*).

FAM. 21. TAMARICACEÆ.

Small trees or shrubs with alternate scale-like, exstipulate, sometimes amplexicaul or sheathing leaves. Flowers (in our species) in lateral or terminal spikes or racemes, white or pink, regular. Sepals and petals 5, rarely 4, imbricate, free or connate below. Stamens 4–10, inserted on the hypogynous or subperigynous glandular or lobed disc, free or connate; anthers versatile. Ovary free, 1-celled; styles 2–5, free or connate or stigmas sessile. Ovules 2–∞, on broad placentas, anatropous; raphe ventral, micropyle inferior. Capsule 3-valved. Albumen present or 0, embryo straight, cotyledons flat.

1. TAMARIX, *L.* Tamarisk.

Characters of the family. Ovary narrowed upwards; styles 2–4, short, dilated into the stigmas. Ovules many. Seeds plumose, exalbuminous. Embryo ovoid.

Stamens 10. Fls. ·2″–·25″ long . . . . 1. *ericoides.*
Stamens 5. Fls. under ·13′ long.
  Fls. 1-sexual. L. tubular except at tip . . . . . . 2. *dioica.*
  Fls. 2-sexual. L. appressed, sessile, but not tubular . . . 3. *indica.*

1. **T. ericoides,** *Rottl.* Jhao, *H., K.*

A pretty shrub, 3–5 ft., with fastigiate branches, and sheathing, amplexicaul, shortly acuminate, glaucous, scale-like leaves, which are persistent and brown on old branches. Flowers pretty heath-like pink in dense erect racemes 1·5–6″ long; perianth marcescent, ·2–·25″ long, the sepals only half as long as the corolla. Capsule ·4–·5″ long, 2–3-valved, opening and disclosing the silky coma of the seeds.

Along river beds in the Northern and Central Tracts, frequent! Southern tract, Sambalpur. The commonest species in the Province. Fl., Fr. Oct.-April. Evergreen.

The bracts are ovate-acuminate.

2. **T. dioica,** *Roxb.* Jhao, Lal Jhao, *Beng.*; Thar-thari, *Vern.*

A small tree with short trunk with very numerous spreading branches with drooping tips, and sheathing, amplexicaul, scale-like, obliquely-truncated acute leaves. Flowers diœcious, very numerous, pretty, pink, in drooping panicled spikes with triangular bracts. Petals linear-oblong, only about half the size of the last. Stamens 5; anthers purple in the male and 2-lobed, in the female sagittate and pale. Capsule 3-valved, not longer than the corolla.

Islands of the Ganges, *Roxb.*; Ganges near Rajmahal, *Hole*; Kalahandi, *Cooper.* I have not seen the specimens from our area, but from Oudh, not far off. Fl. Aug. Bark dark coloured, cracked.

3. **T. indica,** *König.* Jhao, jeora, *Vern.*

A small tree up to 2 ft. girth with habit of the last, but the scale-like leaves not sheathing or amplexicaul, although appressed to the twigs; imbricate on the young twigs. Flowers only ·04–·06″, white or pink, in drooping panicled racemes, 2-sexual. Bracts spreading, lanceolate-acuminate. Sepals orbicular, not half as long as the petals. Stamens 5, twice as long as the petals. Anthers 4-lobed (*Roxb.*) and apiculate (as in the others). Capsules ·12″, 3-valved.

Sandy higher ground in the tidal forests of the Mahanadi! Beds of rivers, Champaran! But in neither case seen in flower. Fls. Aug.-Sept. Bark dark or cracked as in the last.

FAM. 22. HYPERICACEÆ.

Herbs or shrubs, rarely trees. Leaves opposite, exstipulate, often punctate with glands, entire or gland-toothed. Flowers solitary or cymose, terminal or axillary. Sepals and petals 5–4, petals contorted in bud. Stamens ∝, in 3–5 bundles, rarely quite free; anthers versatile. Ovary 3–5- or 1-celled, with 3–5 free or united styles. Ovules few or many, axile or parietal, on 3–5 placentas, anatropous. Fruit usually capsular. Seeds exalbuminous.

1. HYPERICUM, *L.*

Leaves usually sessile. Flowers yellow. Capsule septicidal, or dehiscing at the placentas in 1-celled ovaries.

Shrub with showy Fl. Styles free . . . . 1. *Gaitii.*
Small herb with small Fl. . . . . 2. *japonicum.*
Cultivated shrub. Styles united except at top . . . . . 3. *chinense.*

1. **H. Gaitii,** *Haines* (*Journ. As. Soc.*, xv, p. 7).

A much-branched handsome shrub, 3–5 ft. high, with stems attaining 6″ girth, with opposite-sessile somewhat glaucous leaves, 2–2·5″, and short 3-chotomous cymes of showy yellow flowers, 2–2·25″ diam. Capsule ·7″ long, conical.

Along streams, Neterhat Plateau! Fl. April–June. Fr. May–June (perhaps also r.s.).

Branchlets terete. L. elliptic-oblong, oblong-lanceolate or oblanceolate, gland-dotted, paler beneath, with 2–3 secondary nerves near the rounded base which reach far forward. Sepals ·3–·5″, imbricate, ovate- or oblong-lanceolate. Petals obovate, 1–1·2″ by ·8–·9″. Stamens very many, in 5 bundles, ·5–·7″ long. Styles ·5″, longer than the ovary, which is ·3″ in flower. Ripe dehiscent capsules somewhat shorter than before dehiscence from the contraction of the outer pericarps which causes the dehiscence. Seeds brown, polished, linear, 1 mm. long.

2. **H. japonicum,** *Thunb.*

A herb with erect tufted stems 3–5″ high, or sometimes diffuse and nearly 12″; branches sharply 4-angled. Leaves ·2–·25″ long, sessile, erect, elliptic or oblong, pellucid-dotted, 3-nerved. Small yellow flowers, ·25″ diam., solitary in the forks or axillary and terminal. Sepals linear-lanceolate to ovate, 3–9-nerved. Capsules 3-valved, not exceeding the sepals.

Chota Nagpur, common, especially in elevated grass lands and damp places. Fl., Fr. April–June.

3. **H. chinense,** *L.*

A cultivated shrub, somewhat resembling *H. Gaitii*, with ovate leaves 2·5–3″, somewhat amplexicaul (var. *Prattii*), or 1–2·5″ and elliptic-oblong (in type), conspicuously dotted. Sepals very variable in length, often ·5–·6″, elliptic-oblong, obtuse. Petals 1–1·2″. Stamens ·75–·8″. Ovary ovoid, with styles ·7″ long, united to near the top and then 5-cleft. Capsule only ·25–·3″. Bettiah!

FAM. 23. GUTTIFERACEÆ.

Trees or shrubs with resin canals containing a greenish or yellow latex, and opposite usually evergreen and coriaceous leaves, generally with very close fine parallel secondary nervation. Stipules 0 or intrapetiolar. Flowers often showy, 1–2-sexual, sometimes diœcious. Sepals 2–6, imbricate, or in decussate pairs. Petals 2–6, imbricate or contorted. Male flower, stamens indefinite, hypogynous; filaments free or monadelphous or connate, in as many bundles as there are petals. Anthers dehiscing by pores or slits or circumsciss. Female flower with staminodes. Ovary 1–many-celled. Style 1 or 0. Stigmas free, or connate or peltate. Ovule 1–2 or many axile, or basal and erect. Fruit baccate. Seeds large, albumen 0. Cotyledons small and tigellus very large, or cotyledons thick, free or connate with small radicle.

I. *Garcineæ.* Ovary cells 1-ovuled. Style short or 0.
  Calyx of 4–5 sepals . . . . 1. *Garcinia.*
  Calyx closed in bud, bursting into 2 valves . . . . 2. *Ochrocarpus.*
II. *Callophylleæ.* Ovary cells with 1–4 erect ovules. Style distinct.
  Ovary 1-celled, 1-ovuled . . . . 3. *Calophyllum.*
  Ovary 2-celled, cells 2-ovuled . . . . 4. *Mesua.*

1. GARCINIA, *L.*

Trees with yellow resinous juice. Calyx of 4–5 sepals. Petals 4–5. Flowers polygamous. Male stamens many, free, or variously connate; anthers sessile on the staminal column or on short thick filaments. Female flowers with 8–many free or connate staminodes. Ovary 2–12-celled. Stigma peltate, entire or lobed. Ovule 1 in each cell, axile. Seeds arilled.

Sepals 4. Petals 4. L. 3–5″ . . . . 1. *cowa.*
Sepals 4–5. Petals 4–5. L. 6–14″ . . . . 2. *Xanthochymus.*

1. **G. cowa,** *Roxb.* Soroa, *Ho.*; Kowa, *Beng.*; Sarbana, *Or.*

An erect tree, 30–40 ft., with many slender and drooping branches from quite close to the ground and dark shining lanceolate or oblanceolate leaves, 3–5″, with slender rather obscure secondary nerves meeting in an intra-marginal one. Flowers yellowish, rather fleshy, 1–4 in the leaf axils or terminal and clustered. Fruit yellow, about 2″ diam., 4–8-grooved and celled.

Along streams. Hills near Monghyr, *F.B.I.*; Saranda and Porahat Forests, Singbhum, rare! Athmalik State (Bamur)! Mayurbhanj! Mals, Puri!
Fls. March–April. Fr. May–June. Evergreen.
Blaze red, exuding small drops of yellow milky juice. L. membranous when dry, often oblong-lanceolate, rarely somewhat obovate, sometimes 6″ long, acute or acuminate, tapering into the ·3–·5″-long petiole; secondary nerves indistinct in fresh leaves; very fine oblique, about 12–16, reaching the intramarginal nerve. Stipules minute, fugacious, leaving a stipular line. Fls. axillary and in sessile terminal cymes, with the short pedicels at first fused, males usually terminal, and females axillary. Sepals ·15–·2″. Petals ·3–·4″. Stamens many, in a 4-rayed central mass, anthers sub-sessile, 4-celled.
The Fr. is eaten and is of pleasant flavour.

2. **G. Xanthochymus,** *Hook. f.* Syn. Xanthochymus pictorius, *Roxb.* Dampel, *Beng.* (fide *Prain*); Cheoro, Chiuri, Sitambu, *Or.*

A handsome, small or moderate-sized, straight (in the forest) tree, with spreading branches nearly down to the ground, and very large oblong or linear-oblong very coriaceous shining leaves attaining 13·5 by 4″. Flowers cream-coloured, ·5″ diam., globose, clustered on woody bracteate tubercles from axils of fallen leaves. Fruit bright yellow when ripe, 1·5–2·5″ diam.

In dense evergreen forest, near streams. Mals of Puri (Dhuanali)! Mayurbhanj (Meghasani, 3000 ft.)! Bonai, *Cooper*! Planted near the temple, Baruni Hill (Khurda), Cuttack, etc.
Fl. April–May. Fr. May (of following year?).
Blaze exuding scanty drops of a milky juice. Branches 6–8-angled, with a thick green cortex. L. with about 20 fine oblique secondary nerves arching within the margin; tip shortly sharply acuminate, base acute. Under surface with microscopic dots. Petiole ·7–1″, wrinkled, with an adnate, fleshy, intrapetiolar stipule, which covers the terminal bud. Bracts very short, sub-orbicular, bracteoles 2 minute, ·05″, similar. Pedicels ·3–·7″. Sepals orbicular. Petals ·25–·3″, orbicular. Stamens connate into 4 or 5 erect, flat, short spathulate bodies like single stamens with numerous didymous anthers at the top. Ovary globose, with large, sessile, peltate, 4–5-lobed stigma, 4–5-celled. Fr. with milky juice till ripe, on a pedicel 1·2″ long.
Fr. eaten, and the tree is sometimes cultivated for the fruit. It is, however, very acid. It is mentioned in Firminger under the vernacular name of *Tumul.*

2. OCHROCARPUS, *Thouars.*

1. **O. longifolius,** *Bnth. & H. f.* Churiana, *Or.*

A moderate-sized or small tree with handsome dense laurel-like foliage somewhat like that of *Garcinia Xanthochymus ;* leaves oblong or linear-oblong to oblong-lanceolate, acute or obtuse, 5·5–8·5″ by 1·7–2·8″, thickly coriaceous; nervation of very numerous fine parallel secondary nerves copiously reticulate between and with distinct pellucid dots in the areoles. Flowers ·7″ diam., white or rose, in dense axillary fascicles, with numerous subulate bracts at base, at the axils of fallen leaves and from the trunk, pedicels 1″. Calyx bursting into 2 *valves* reflexed during flowering. Petals 4. Fruit 1″, ovoid, 1-seeded.

Khurda, cultivated, *Haslett!* This tree is stated in *Bengal Plants* to be found in Khurda, Orissa, and the vernacular names of Nagesar, *Beng.*, and Chiuriana, *Or.*, are given for it. It was doubtless a cultivated specimen, as the tree is known to have been introduced near Kuhuri by a former Raja and about 12 acres existed in 1881.

"A specimen near the Baruni Hill Temple recently died," *Haslett.*

"The Fls. are used like those of Nageswar in Hindu worship," *Haslett.*

3. CALOPHYLLUM, *L.*

Trees with opposite shining coriaceous leaves, with innumerable parallel very slender secondary nerves at right angles to the midrib. Flowers panicled. Sepals and petals 4–12, imbricate, in 2–3 series. Stamens very many, filaments slender. Ovary 1-celled, with slender style and peltate stigma. Ovule solitary, erect. Fruit a drupe.

1. **C. inophyllum,** *L.* Punang, *Or.*; Sultana Champa, *Beng.*; The Alexandrian Laurel.

An exceedingly handsome moderate-sized tree, with large glabrous, oblong, elliptic-oblong or obovate-oblong, obtuse or emarginate leaves, 4–8″, shining on both surfaces, and axillary lax drooping racemes 4–6″ long, of large white fragrant flowers ·75″ diam. Drupe globose, yellow and pulpy when quite ripe, 1″ diam.

Orissa coast, extensively cultivated, but doubtfully wild. Is also much planted in Cuttack and other stations not far from the sea. Fl. May–June and again Oct.–Nov. Fr. Oct.–Nov. and April–May.

Juice (of the resin canals) bright green. Petiole ·5–1·2″. Pedicels of flowers 1–2″. Sepals 4, inner petaloid. Petals 4. Stamens in 4 bundles.

The wood is sometimes known as Mast wood and is said to be good. Gamble says reddish-brown, moderately hard, and close grained. The seeds yield an oil known as Pinnay or Domba oil, used for burning, which has recently been recommended as a lubricant in place of castor. The seeds are collected twice a year (see above), *Haslett.*

The tree is being grown in the Casuarina Plantation on the Puri Sands.

4. MESUA, *L.*

Trees with opposite coriaceous leaves, with innumerable very slender secondary nerves at right angles to the mid-rib. Flowers polygamous, large, solitary, axillary or (apparently) terminal. Sepals and petals 4, imbricate. Stamens very many, with slender filaments. Ovary 2-celled, with long style and peltate stigma. Ovules 2 in each cell, erect. Fruit sub-capsular, 1-celled by absorption of the septum. Seeds ex-arillate.

1. **M. ferrea,** *L.* Nagesar, Nageswar, *Or., Beng.*

A moderate-sized or large, very beautiful tree, with straight trunk branched to near the ground, with linear-lanceolate drooping leaves, 3–6·5″ long, dark and shining above and whitish beneath, and white flowers from the uppermost leaf axils. Fruit ovoid, with conical pointed apex, 1–4-seeded, supported on the persistent calyx, almost woody, 1–2′.

Purneah, *Ham.* Near streams. Mayurbhanj (Bhanjabasa), rare! Mailagiri Reserve, Palahara State, *Cooper*! Often planted! Fl. April–July. Fr. Oct.–Nov. Evergreen. New L. in March, brilliant crimson.

Attains 7 ft. girth. L. 1–1·75″, broad, acute, or mostly acuminate; secondary nerves scarcely visible; marginal vein rather strong. Petiole ·3–·5″. Fls. very variable in size, fragrant, ·75–3″ diameter. Sepals orbicular, thick. Petals cuneate-obovate. Stamens bright yellow.

A form with L. green beneath is said to occur (*Gamble*), but has not been seen in our area. *Cooper* states that in the Mailagiri Reserve the tree is gregarious over an area of some 100 acres and up to 7 ft. girth. This gregarious habit is common to it in Eastern Bengal. The wood is dark red and durable, but almost too hard to work. Seed should be sown *in situ*, as it stands transplanting with difficulty.

FAM. 24. TERNSTRŒMIACEÆ.

Trees or shrubs with alternate, simple, exstipulate, usually coriaceous leaves. Flowers usually showy (small in *Eurya*), and subtended by 2 sepal-like bracts, axillary, solitary or clustered, rarely on many-flowered peduncles. Sepals 4–7, free or slightly connate. Petals 4–9, imbricate or contorted in bud, free or connate below. Stamens ∞, free or connate, usually adnate to base of corolla. Anthers basi-fixed or versatile, opening by slits or pores. Ovary free, sessile, 3–5-celled, with as many free or connate styles. Ovules 2–∞ in each cell, axile. Fruit baccate or capsular. Seeds few or many, albumen scanty or 0. Embryo straight or curved.

A specimen of *Eurya symplocina, Blume*, was found in my herbarium labelled "Chota Nagpur"—almost certainly in error. It probably came from British Bhotan. *Eurya acuminata, DC.*, occurs in the Sikkin Tarai close to, but has not been found in our area.

1. CAMELLIA, *L.*

Trees or shrubs with evergreen, coriaceous, serrate leaves and axillary, often large and handsome flowers. Sepals 5–6, graduating from the bracts towards the petals, which slightly cohere at the base. Stamens ∞, outer more or less monadelphous and adhering to base of petals; innermost free. Ovary 3–5-celled; ovules 4–5 in each cell. Capsule woody, short, loculicidal. Seeds usually solitary in each cell or reduced to 1 or 2 altogether. Albumen 0. Embryo straight with large, thick cotyledons.

1. **C. theifera,** *Griff.* Cha, *Vern.*; The Tea Plant.

A large shrub or small tree, but usually kept pruned except in the "seed-baris." Formerly much cultivated on the Chota Nagpur plateau and on Parasnath, but the rainfall is scarcely sufficient, and the tea industry in Chota Nagpur has largely declined. Formerly also the plants were chiefly of the small-leaved China variety, but blanks are now filled in with the more prolific hybrid.

FAM. 25. DIPTEROCARPACEÆ.

Trees, rarely climbers, with resinous substances contained in cavities and canals in leaves, wood or bark. Leaves alternate, simple, entire, with parallel secondary nerves, stipules present, at least when young, often leaving an annular scar. Flowers in axillary or terminal racemes or panicles. Torus usually broad and concave. Sepals 5, connate into a tube below, often unequal. Petals 5, contorted, sometimes connate at the base. Stamens 5 or in multiples of 5, often many, one or more seriate, hypogynous or sub-perigynous, sometimes connate or adnate to the petals; filaments short, anthers basifixed introrse, connective often appendaged. Ovary slightly sunk in the torus, 3-, rarely 2–1-celled, styles fused. Ovules 2 in each cell, anatropous, pendulous.

1. SHOREA, *Roxb.*

Flowers in axillary or terminal lax cymose panicles; bracts often caducous, sometimes 0. Sepals connate at base only and adnate below to the torus, imbricate, persistent and enlarged in fruit. Stamens 15 or ∞; connective of anther usually appendiculate. Ovary 3-celled, style subulate. Fruit indehiscent, 1-seeded, embraced by the bases of the accrescent wing-like sepals, of which 3 are sometimes larger than the others. Cotyledons fleshy, unequal, one embraced by the other; germination hypogeal.

1. S. robusta, *Gaertn.* Sal, *H., Beng.*; Sarjom, *K., S.*; Sakwa, *Th., Kharw.*; Salwa, Rengal, *Or.*; The Sal Tree.

A tree attaining 150 ft. and 12 ft. girth, but often low and stunted on the hills. Leaves ovate or ovate-oblong, cuspidate, with cordate base. Flowers cream-coloured, unilateral on the branches of tomentose panicles 5–9″ long. Petals lanceolate-acuminate, ·5″. Fruit ·5″, ovoid, beaked with the style; wings 2–4″, linear-oblong or spathulate, subequal, with three rather larger.

Throughout the Province, excepting the low-lying tracts of the Gangetic Plain, ascends to the tops of the highest hills, and also occurs not far from the sea on high ground in Cuttack and Puri. Fls. March–April, or in some years up to May. Fr. June–July. Nearly or quite leafless in March. The new L. appear with the Fls.

Bark dark brown, sometimes reddish, furrowed, or in old trees grey and nearly smooth. Blaze red, tough and fibrous. Shoots pubescent. Stipules ·25–·5″, falcate, covering the young buds. Petioles short and stout. Panicles on the new shoots and direct from the old wood. Petals with a twisted acumen. Stamens with a very swollen base, but slender below the anthers and connective tailed, cells often apiculate.

On germination the radicle issues from the nut close to the base of the style, and with the hypocotyl is thrust far out of the seed by the rapidly elongating stalks of the cotyledons. These are very thick, somewhat crescent-shaped, but cuneate on the long petiole and the outer arc somewhat emarginate. The stalks of the cotyledons are not exactly opposite on the hypocotyl, but the first pair of leaves are opposite. Buds frequently arise serially in the axils of the cotyledons, and these give rise to new shoots when the stem is killed or broken. These buds may also account for the wonderful coppicing power of the young tree from the ground or below it even when cut rather high up, and for the fact that Sal coppiced too close to the ground frequently dies. The seed sometimes contains two embryos (teste *Sen Gupta*).

The wood of the Sal varies when freshly cut from reddish to nearly white. The white-timbered Sal is called *Sakwi* in Nepalese and Tharu, and is considered superior to *Sakwa* or red Sal. The best time for felling poles for rafters, etc., is said to be October, but the best time sylviculturally when coppice is required is in

the hot season. The bark should be removed as soon as felled on account of borers. The seed should be sown immediately it falls as it soon loses the power of germination. The first to fall are usually bad.

Oil expressed from the seeds or obtained by simple boiling is used for cooking and burning in Sambalpur, and the seed is eaten in times of famine, and regularly by the Santals, but is unwholesome. The resin (dunra, *K.*; sarjam lore, *S.*) is used in medicine and for caulking. Before the reservation of the forests trees were killed in large numbers by resin tapping. The bark is employed as a tan. The leaf forms the covering of the Kol cigarette (fikr).

FAM. 26. MALVACEÆ.

Trees, or more usually shrubs or herbs, mostly with stellate hairs and with tough branches from the strength of the bast fibres. Leaves alternate, stipulate, with palmate venation, simple or digitate. Flowers regular, often showy, nearly always with an epicalyx (bracteoles). Sepals usually 5, valvate, connate below. Petals 5, imbricate and twisted, often connate below. Stamens ∞ (15 in *Kydia*), more or less monadelphous into a tube, which is often adnate to the base of the corolla and branches into free filaments above, or pentadelphous, or some filaments quite free. Anthers variously shaped, ultimately 1-celled. Ovary 3–4- but usually 5–many-celled, capsular in fruit or breaking up into dehiscent or indehiscent cocci which fall away from a columella. Ovules 1–more, axile, curved. Albumen scanty or 0. Cotyledons foliaceous, usually crumpled or folded, and mostly palmately nerved. Germination epigeal (where observed by me).

The family abounds in mucilage and most of the species yield a fibre from the bast.

A. Stamens united into a long tube with free part of filament very short or 0 (exc. *Ab. polyandrum*). Shrubs or herbs, rarely small trees.
- I. *Malveæ.* Carpels 5 to many. Styles as many as carpels. Fruit of as many cocci. Fls. usually yellow.
  - *a.* Ovule 1 in each carpel.
    - Bracteoles 3. Stigmas linear . . . . . . 1. *Malva.*
    - Bracteoles 3. Stigmas capitate . . . . . 2. *Malvastrum.*
    - Bracteoles 0 . . . . 3. *Sida.*
  - *b.* Ovules 2 or more in each carpel. Bracteoles 0 . 4. *Abutilon.*
- II. *Ureneæ.* Carpels 5. Styles or stigmas twice as many. Fr. of 5 cocci. Fls. usually red.
  - *a.* Fls. in dense heads intermixed with bracteoles . 5. *Malachra.*
  - *b.* Fls. not in dense heads.
    - Bracteoles 5. Carpels opposite petals, often spinescent . . . . 6. *Urena.*
    - Bracteoles 10. Carpels opposite sepals, smooth . 7. *Pavonia.*
- III. *Hibisceæ.* Carpels 3–5. Stigmas as many as carpels or connate. Fr. capsular. Staminal tube truncate or 5-toothed.
  - *a.* Stigmas distinct. Bracteoles 5–more (exc. *Solandra*) 8. *Hibiscus.*
  - *b.* Stigmas coherent in a club-shaped mass.
    - Bracteoles 3–5, small . . . . 9. *Thespesia.*
    - Bracteoles 3, large and usually cordate . . . 10. *Gossypium.*

B. Stamens united at the base only and pentadelphous or quite free. Trees.
- IV. *Bombaceæ.* Sepals coriaceous. Fr. capsular or indehiscent.
  - *a.* L. simple, lobed. Bracteoles 4–5, persistent . 11. *Kydia.*
  - *b.* L. digitate.
    - Calyx cupular, slightly irregularly lobed . . 12. *Bombax.*
    - Calyx 5-cleft with 2 bracteoles . . . . . 13. *Adansonia.*

The well-known garden plants, Hollyhock (*Althæa rosea*) and Malope, also belong to this family. The bracteoles in *Althæa* are 6–9, connate at the base.

1. MALVA, *L.* Mallow.

Herbs with lobed palminerved leaves. Flowers axillary, clustered. Bracteoles 3, free. Ovary many-celled, styles as many as carpels.

1. M. verticillata, *L.*

Branches often woody below, 2–3 ft. high. Leaves suborbicular, 5–7-lobed and crenate, lower often 3–4·5″ diam., upper sometimes only ·5–1·5″. Flowers pink, in dense clusters, with short pedicels. Corolla ·5″ long. Carpels 10–12, reticulate or pitted.

It occurs both sides of the province, in Oudh and N. Bengal, and will probably be found within it. Fl. June, July.

2. MALVASTRUM, *A. Gray.*

Herbs or undershrubs with simple or rarely lobed leaves. Flowers axillary or terminal. Bracteoles 3. Ovule 1, ascending in each carpel. Ripe carpels indehiscent, 1-seeded, sometimes beaked or awned. Otherwise like *Sida*.

1. **M. coromandelianum,** *Garcke.* Syn. M. tricuspidatum, *A. Gray.*

An undershrub or herb 1–3 ft. high, sometimes gregarious, with strigose branches, oblong-ovate or rhomboid-ovate serrate leaves ·8–2″ long, sparsely hairy both sides, and solitary yellow flowers ·5–·6″ diam. Sepals acuminate, including tube ·35″ long, connate half-way up. Carpels 3-cuspidate, strigose.

An introduced weed! Fls., Fr. July–Nov. It much resembles a *Sida*.

3. SIDA, *L.*

Herbs or undershrubs with stellate hairs and simple or lobed leaves. Flowers rarely over ·75″ diam., yellow or straw-coloured or nearly white, *without* bracteoles. Sepals connate into a broad tube below. Staminal tube adnate to base of petals, dividing above into numerous filaments. Carpels 5–10. Ovule 1, pendulous. Fruit not depressed at the top (cp. *Abutilon*) and carpels usually 2-awned at the apex. Ripe carpels split ventrally and from between the awns. Seed solitary. The 5-angled or 10-nerved calyx is persistent long after the seeds have dropped.

The *Sidas* open about 10 a.m. or towards mid-day.

I. Lower petioles long, ·75″ or more, often three-fourths as long as the L. L. ovate to orbicular with cordate base, 5–9-nerved.
- *a.* Carpels 5, awned or not.
  - Trailing or sub-erect amongst bushes, eglandular . . 1. *veronicæfolia.*
  - Erect with numerous glandular hairs . . . . . 2. *glutinosa.*
- *b.* Carpels 8–10, long-awned. Tomentose . . . . . 3. *cordifolia.*

II. Petioles nearly always under ·75″. L. oblong, rhomboid or obovate, 3-nerved.
- *a.* Carpels 5. Stipules shorter than the petiole. L. obtuse or rounded . . . . 4. *spinosa.*
- *b.* Carpels 10–5. Stipules usually longer than the petioles.
  - L. hoary or stellate beneath, lower usually broadly rhomboid or obovate, peduncles often long . . . 5. *rhombifolia.*
  - L. glabrous beneath, usually narrow, oblong or lanceolate, peduncles mostly as short as the petioles . . 6. *acuta.*

1. **S. veronicæfolia,** *Lamk.* Syn. S. humilis, *Willd.* Bariar, *K.*, *S.*; Janka, *Beng.*

A procumbent herb on open pasture land, or trailing or sub-erect 1-3 ft. high amongst bushes, hairy, with long spreading hairs as well as stellate ones. Leaves sub-orbicular or ovate, cordate, obtusely serrate or crenate-serrate, acuminate, ·5–1″ long, or attaining 3·5″ by 2·75″ in forest forms. Petiole and peduncles both slender, ·5–2″. Carpels mucronate, cuspidate or awned.

In all situations; throughout the province. Fls., Fr. chiefly at the end of the rains, but more or less all the year.

Sometimes almost woody below. L. 8-9-nerved from base. Fls. straw-coloured or yellow, ·5″ diam., 1-2-axillary, and loosely arranged in racemes or panicles from the reduction of L. Peduncles as long as or rather shorter than the petioles, jointed about half way.

The procumbent small-leaved form is often less hairy than the large one, but the species can by no means be limited to this; all gradations occur.

It yields a good fibre. L. are eaten, *Camp.*

2. **S. glutinosa,** *Cav.* Syn. S. mysorenis, *W. & A.* Vernacular names as in last.

An erect, stouter and more hoary plant than the last, to which it is very closely allied. It is much more densely pubescent, and many of the hairs are glandular. Leaves 1–3″, petioles less slender. Pedicels much more congested, usually forming a close glandular panicle towards the top of the stem.

Much less common. Chiefly in the Santal Parganas! Chota Nagpur! Bihar, *Prain.* Fls., Fr. Oct.–Jan.

3. **S. cordifolia,** *L.* Bariala, Bariar, *Vern.*

An erect undershrub 2–4 ft., tomentose all over, and with thin spreading hairs on the stem. Leaves 7–9-nerved, ovate or ovate-oblong, cordate, acute or obtuse, crenate, 1·25″ by 1″ to 3″ by 2·5″, with petioles about ¼ to ¾ as long. Peduncles 1–2, axillary and sub-corymbose, with the lower ones attaining 1″. Carpels 10–8, with 2 long retrorsely hispid awns.

Waste places throughout the area, especially in scrub jungles in Palamau. Fls. Aug.–Dec. Fr. Oct.–Jan.

This species comes very close in some respects to *S. glutinosa* and it also has glands amongst the tomentum, but the plant is easily recognised by the L. being softly hoary-grey, tomentose both sides and never acuminate, while the calyx is very broad, ·3–·4″ diam. in fruit, with triangular, not acuminate lobes. Corolla straw-coloured, ·5″. Carpels reticulate, with the awns nearly as long as themselves.

Var. **Burkillii.**

A woody procumbent form from the sandy banks of the Mahanedi near Cuttack. It has small L., ·5″. Collected August by *Mr. Burkill.*

4. **S. spinosa,** *L.* Syn. S. alba, *L.*; S. alnifolia, *Roxb.*; Bariar, *H.*

A small, erect, shrubby weed, about 1 ft. high, with small leaves always rounded at the end, rarely 2″ long, crenate or crenate-serrate, hoary tomentose beneath, with the filiform stipules mostly shorter than their petioles. Flowers yellow or pale, usually fascicled on short shoots. Joint of peduncle usually above the middle, often

obscure. Carpels not exceeding 5, either 2-awned or with only 2 short points.

Northern Tract, very common on railway embankments in Purneah! Chota Nagpur! Behar, *Prain*. Fls., Fr. c.s.

Appearance often exactly that of forms of *S. rhombifolia*, except for its greater compactness and rigidity, the short peduncles clustered on abbreviated shoots, and in the cold season the large L. usually drop off, leaving the small ones about ·25″ long only. The plant is then very weedy and unsightly as the small L. do not cover the numerous twigs. Two tubercles often occur at the sides of the old leaf-scars. Base of L. sub-cuneate to rounded and sub-cordate. Petioles very variable, ·5–·8″ long, or under ·2″ on the shoots. Peduncles often as short as the petioles in flower, but usually ·25–·5″ in fruit. Seeds smooth, without a prominent tongue near the micropyle.

Roxburgh figures his *S. alba* with small white Fls. only ·3″ diam., and awns up to ·2″, and *S. alnifolia* with Fls. deep yellow, ·5–·7″, and carpels with 2 short points only. Our plant corresponds rather with the latter form.

5. **S. rhombifolia,** *L.* Syn. S. rhomboidea, *Roxb.*; Ipirpijon, *K.*; Lal berela, *Beng.*

A herb or undershrub, 1–4 ft. high, with stellate hairs on the branches. Leaves narrowly or broadly rhomboid or obovate, always cuneate at the 3-nerved base (but wedge sometimes wide and its apex obtuse or emarginate), pale or hoary, and always more or less stellate pubescent or tomentose beneath. Peduncles slender, jointed at or below the middle, the lower (at least) far exceeding the petioles. Carpels 5–9, awns variable.

Very common in waste ground, roadside, forest glades, etc. Fl., Fr. Aug.-Dec.

It is very variable and the extreme forms look like distinct species, but numerous connecting links may be found. A separate species (rhomboidea, *Roxb.*) is sometimes founded on the peduncle being jointed at base and the carpels muticous, but these characters do not always go together, nor do they coincide with any particular distinction of habit or leaf-form. Were it to be divided up, I should keep var. *obovata* distinct.

The following forms occur in our area:

a. rhombifolia proper.

Suffruticose, 2–6 ft. L. rhomboid-lanceolate serrate, or lower L. rhomboid and upper lanceolate to linear-lanceolate, crenate-serrate, pale or hoary, and thinly stellate beneath, 1·5–2·5″. Stipules linear setaceous, hairy, about equalling the petiole, which is ·15–·28″ long. Peduncles solitary, ·8″, jointed in the middle. Fruiting carpels 8–9, more rarely 10, with 2 long erect awns, slightly hairy at the back.

Roxburgh says "capsules 10, with *one* straight sharp horn," but I think that this must be an error. Chota Nagpur; Ichadag, 2500 ft. and other places!

β. As in the last 2–4 ft. high, but peduncles ·2–·5″, axillary, and clustered towards the ends of the branchlets, and often jointed low down.

Damp localities in Singbhum, common!

γ. rhomboidea, Roxb. (Sp.).

L. narrow, rhomboid, peduncles solitary, carpels without awns. Manbhum!

δ. obovata, F.B.I.

Stems often procumbent. L. broadly-rhomboid, obovate or rounded, crenate or crenate-serrate, sometimes only ·5–1″, and others 2·5″ long, hoary beneath, with stellate tomentum. Fruiting calyx ·25″ or less. Peduncles often under ·5″, often densely clustered. Tongue over the micropyle of the seed very broad. Carpels only 5 (always?). Awn not one-fourth as long as carpels and sometimes obsolete.

In dry places, common. Bettiah! Hazaribagh! Also Parasnath!

Fibre of this plant was sold in London in 1913 at £36 per ton, but a larger sample in June, 1916, badly prepared, 2-6 ft. long, mostly 3-4 ft., was valued at £17-£18 per ton c.i.f. London, with Calcutta jute at £28. It was considered that even this would be suitable for mixing with jute when the price of the latter is high. (*Capital*, Oct. 5th, 1917.)

To obtain long staple fibre, and in sufficient quantity, the plant must of course be cultivated in close crops, but good seed could no doubt be obtained to start with from some of the tall forest varieties.

6. **S. acuta,** *Burm.* Syn. S. carpinifolia, *F.B.I.*; Ipirpijon, *K.*; Ipirpichig, *M.*; Bir miru baha, *S.*; Ancharna, *Or.*

An erect undershrub, or herb, usually 2–3 ft. high, with very tough, sparsely stellate-hairy stems, lanceolate to obovate-lanceolate serrate glabrous leaves 1·5–3·5″ by ·5–1″, and pale yellow flowers on jointed peduncles, which are mostly shorter than the ·25″ petioles. Stipules hairy linear, or one linear and one setaceous in each pair, ·3–·5″ or more long.

Waste ground throughout the area, common. Fls , Fr., Aug.-Dec.

Pale green or frequently variegated with yellow. L. gradually tapering, scarcely acuminate, base 3-nerved, sometimes rounded; secondary nerves, 5-8, extending nearly to margin. Peduncles jointed about the middle. Sepals acuminate ciliate. Carpels usually 5-6, reticulate, shortly 2-aristate.

Yields a good fibre, and I have seen it 5 ft. high. Plant used for brooms in Orissa.

4. ABUTILON, *Gaert.*

Undershrubs more or less downy, with angled, palmately-lobed or entire leaves and orange ebracteolate flowers, usually 1″ diam. or more, opening in the evening. Pedicels articulate. Petals connate below and adnate to the staminal tube, which is divided at the apex into numerous filaments. Carpels exceeding 5 (exc. *polyandrum*), in fruit separating as 2-valved usually 2–3-seeded, cocci from the persistent axis; apex of fruit depressed or truncate, awns or mucros, if persistent, on the shoulders. Seeds reniform.

1. Andrœcium only tubular at the base. Carpels 5-6 . . . . 1. *polyandrum.*
2. Staminal tube long. Carpels 15 or more.
   Not hairy except the fruits, peduncles slender, cocci truncate, shortly awned on the shoulders . . . . 2. *indicum.*
   Hairy as well as pubescent, peduncles stout, cocci rounded muticous or mucronate . . . . 3. *hirtum.*

1. **A. polyandrum,** *W. & A.*

A tall suffruticose herb 5–6 ft. high, very glandular above and with a peculiar smell. Leaves long-petioled, orbicular or ovate, cordate, acuminate, 4–5″. Flowers orange, 1·5″ diam., in loose panicles. Staminal tube short with a hirsute ring at top. Cocci 5–6, awned.

Chiefly in the forest, but not at all common. Champaran, Ramnagar Forest! Tandi Forest, Manbhum (*Campbell*)! Parasnath (*Anders.*); Kochang (*Gamble*). Fls. May-Oct. Fr. Sept.-Nov. Biennial, or lower portions perennial.

L. reband-dentate, densely shortly pubescent, especially beneath. Staminal tube forming a cone over the ovary, then dividing into about 40 long filaments. Carpels hairy and glandular. Seeds 3-4, pale brown with minute scattered warts.

2. **A. indicum,** *G. Don.* Mirubaha, *S.*; Kakhi, *Kharw.*; Kanghi, *H.*

An undershrub covered with a soft, white, close velvet, with few or no long hairs intermixed. Flowers about 1″ diam., on very slender

peduncles two to three times the length of the subtending petioles, and usually deflexed at the joint. Head of carpels truncate, exceeding in diam. the fruiting calyx, usually with short awns on the shoulders, stellately hairy.

Waste ground and usually near villages in all the districts, but rather local. Fls. r.s. and up to Dec. Fr. chiefly Nov.–Jan. Ripe seed, however, also collected in June, and it probably flowers at most times of the year.

L. usually dentate and acuminate (var. populifolium, *W. & A.*), sometimes lobed, 1·5–3″. Stipules small, deflexed. Petiole three-fourths as long as the blade. Peduncles solitary, axillary, 1·5–2·5″, sometimes appearing sub-panicled before the leaves develop.

3. **A. hirtum,** *G. Don.* Syn. A. graveolens, *W. & A.* Barkanghi, *H.*

Suffruticose, 3–6 ft. high, the whole plant covered with a tomentum much as in *A. indica*, but also with glandular pubescence and long soft hairs on the branches, peduncles, etc. Flowers 1·5″ diam., orange with a crimson centre, on solitary, axillary peduncles, together (usually) with another flowering branchlet. Head of carpels rounded, muticous or mucronate, densely stellate, pubescent. Fruiting calyx as broad as the fruit.

Similar localities to *A. indicum*, Singbhum, frequent! Manbhum, *Ball*! Palaman (common near Japla)! Angul, *Lace*! Fls. Aug.–Dec. Fr. Oct.–Jan.

L. orbicular cordate, entire crenate or slightly toothed, 3–6″ diam. Petioles 3–6″. Stipules spreading or reflexed. Peduncles usually 1·5–2″, stout. Carpels 2–3-seeded. Seeds with a yellow pubescence.

5. MALACHRA, *L.*

1. **M. capitata,** *L.*

A suffruticose herb with stellate bristles on the stems, sub-orbicular and often lobed or angled, cordate crenate-dentate leaves, 4–6″ diam., smaller upwards with hairy and tomentose petioles. Fls. white or yellow, ·3″ long, in dense heads 1″ diam., with prominently veined bracts. Heads on axillary peduncles, ·7–2·5′ long. Calyx angular with 5 subulate, lanceolate, bristly teeth. Ripe carpels, 1-seeded, separating from the axis and lying free in the calyx tube.

Bengal, *Griffith* (without locality). It is a native of America, now rather wide-spread in India, and will probably be found in B. & O.

6. URENA, *L.*

Herbs or undershrubs with stellate hairs, angled or deeply palmately-lobed leaves, and pink, solitary or clustered, axillary flowers, or clusters in more or less leafless terminal racemes. Bracteoles 5, adnate to the calyx and sometimes connate below into a cup. Petals 5, connate and adnate to the staminal tube below. Anthers nearly sessile on the truncate or denticulate tube. Ovary 5-celled, cells 1-ovuled, stigmatic branches 10. Ripe carpels sub-indehiscent or dehiscent, separating from the axis when ripe.

Carpels echinate. L. angled or somewhat lobed . . . . . . 1. *lobata.*
Carpels echinate. L. palmatified . . . . 2. *sinuata.*
Carpels smooth. L. entire or slightly lobed . . . . . . 3. *repanda.*

1. **U. lobota,** *L.* Bhidi janetet, *S.*

Undershrub, 2–4·5 ft., with suborbicular, angled, or shallowly-lobed leaves, 2–4″ diam., often broader than long, with a gland on 1–3 of

the nerves beneath. Flowers pink, ·75″ diam., not racemose. Carpels glochidiate.

Throughout the province, in forest glades and waste lands, common. Fls., Fr. Aug.–Dec.

L. cordate, or upper on flowering branches, rhomboid and acute at base; lobes 3–5 or more obscurely 7–9. Lower petioles long.

It yields a fibre.

2. **U. sinuata,** *L.* Mota bhidi janatet, *S.*; Kunguya, *H.*

Undershrub closely resembling the last, but easily distinguished by its leaves, being lobed beyond the middle into (usually 5) oblong or lanceolate segments, which are contracted at the base and often pinnatifid and serrate. Flowers 1″ diam.

Associated with the last, but rather less common. Chota Nagpur! Angul! Probably throughout the province. Fls., Fr. Aug–Nov.

Yields fibre like the last. Roxburgh says it is a strong and tolerably fine substitute for flax.

3. **U. repanda,** *Roxb.* Sikuar, *S.*

More shrubby than the last two, 2–4 ft., with stiff branches; densely stellate-hairy, roundish repand or somewhat lobed denticulate leaves 2·5–3·5″ diam., and pink, axillary and *racemose* flowers. Carpels *not* glochidiate, easily dehiscent on slight pressure.

Chiefly in open ground. Champaran, common! Chota Nagpur, frequent! Sambalpur! Probably therefore throughout the province. Fls. Sept.–Oct. Fr. Nov.–Dec.

L. very reticulate beneath and mid-rib with a gland near the base. Stipules setaceous. Bracteoles united into a cup below, erect, linear-subulate above, ·3–·5″. Calyx ·3″, lobes linear-oblong, connate three-fourths the way up. Corolla ·5–1″ diam. Staminal tube 1″ long. Seeds ·12″, grey-brown.

7. PAVONIA, *Cav.*

Herbs or undershrubs with entire or lobed leaves. Flowers axillary or clustered or appearing panicled by the reduction of the upper leaves. Bracteoles 5–∞. Staminal tube truncate or 5-toothed at the apex. Ovary 5-celied, styles 10, ovules 1 in each cell. Ripe carpels separating from the axis, indehiscent or dehiscent, never glochidiate.

1. **P. odorata,** *Willd.*

An erect, suffruticose herb, 2–3 ft. high, glandular-pubescent all over, with simple, 3–5-lobed leaves, ·5–2″ long, rounded to ovate-lanceolate. Flowers pink. Bracteoles 10–12, erect, linear, hispidly hairy. Carpels not at all winged, smooth.

Orissa, Puri in dry open forests! Fls., Fr. Oct.–Jan.

Stems hispidly hairy. Lower L. often deciduous at time of flowering. Peduncles ·5–1·5″, axillary, and forming terminal panicles. Bracteoles ·25″, longer than the calyx and carpels. Corolla ·3–·4″ long.

8. HIBISCUS, *Medik.*

Trees, shrubs or herbs, usually suffruticose annuals, or with a perennial root. Leaves more or less palmately lobed. Flowers axillary, or becoming racemose by suppression of upper leaves. Bracteoles 5 or more, rarely fewer or absent, free or connate at the

base. Sepals connate at base, or combined into a 5-toothed or spathaceous calyx, valvate. Petals 5, adnate to staminal tube at the base. Staminal tube truncate, or 5-toothed at the top. Ovary 5- rarely 3-celled, ovules 3-more, style 5-fid above. Capsule loculicidal, with often a distinct endocarp. Seeds reniform, globose or obovoid.

I. Calyx spathaceous, circumciss at base. Bracteoles free. Indigenous species exc. 3 and 6. (Spp. 1–6.)
  1. Fls. yellow with purple eye. Bracteoles many filiform.
    a. Indigenous species. Branches often procumbent. Capsule ·7–2″.
      Fls. mostly in terminal racemes. Capsule with dense spreading persistent hairs . . . . 1. *cancellatus*.
      Fls. mostly axillary. Capsule with appressed deciduous hairs. . . . . 2. *Abelmoschus*.
    b. Cultivated species. Erect. Capsule 6–10″ . . 3. *esculentus*.
  2. Fls. yellow with purple eye. Bracteoles 4–5, lanceolate to ovate.
      Stout, erect, strict, very bristly all over . . . 4. *pungens*.
      Branched from the base, hairs short, scattered . . 5. *tetraphyllus*.
  3. Fls. white or pink. Bracteoles lanceolate to linear, small caducous . . . . 6. *ficulneus*.
II. Calyx 5-cleft, or sepals 5, nearly free. Indigenous species exc. 11 and 12. (Spp. 7 to 16.)
  A. Herbs or undershrubs not woody, except in 15. Bracteoles usually free, or only connate at base (7–15).
  4. Fls. white or pink, under 1″ diameter. Bracteoles 0, or small and linear.
      L. over 2″.
        Herbaceous. L. not glandular. . . . . . 7. *Solandra*.
        Suffruticose. L. glandular beneath. . . . 8. *hirtus*.
      L. under 2″. . . . . 9. *micranthus*.
  5. Fls. yellow with purple eye. Bracteoles linear forked at the apex. . . . . 10. *furcatus*.
  6. Fls. yellow (or white in 12), with purple eye, over 1″ diameter. Bracteoles not forked.
    a. Cultivated species. Bracteoles linear. Peduncles very short.
      Bracteoles adnate to the base of calyx, accrescent . 11. *Sabdariffa*.
      Bracteoles not adnate. Sepals with a large gland . 12. *cannabinus*.
    b. Indigenous species. Bracteoles free. Sepals eglandular.
      Bracteoles linear. Indumentum soft. Capsule winged 13. *vitifolius*.
      Bracteoles linear-spathulate. Indumentum with pungent and glandular hairs. . . . . 14. *panduræformis*.
  7. Arborescent. Fls. pink. Bracteoles oblong. . . . 15. *collinus*.
  B. Trees or large woody shrubs. Bracteoles connate at base into a cup. Capsule with secondary septa (due to the ingrowing endocarp at the margins of the valves).
      L. orbicular crenulate. Fls. yellow. . . . . . 16. *tiliaceus*.
III. Calyx 5-cleft exc. in 20. Large garden shrubs grown for their showy flowers. Fls. rarely yellow.
  1. Calyx 5-cleft. Bracteoles conspicuous.
    a. Bracteoles 10. Fls. white or pink. . . . . 17. *mutabilis*.
    b. Bracteoles 6–8.
      Fls. of various colours, but never lilac or purple. . 18. *rosa-sinensis*.
      Fls. lilac, purple or bluish . . . . 19. *syriacus*.
  2. Calyx spathaceous. Bracteoles minute. Fls. pendulous, red. . . . . 20. *schizopetalus*.

1. **H. cancellatus,** *Roxb.* Usungid, *Ho.*; Bera sanga, *M.*; Uskui, *Birja*; Berua, *Kharw.*; Bir kaskom, *S.*

A very hirsute or bristly herb with very variable leaves, the lower usually sub-orbicular, the upper often narrow and sagittate. Large

yellow flowers, with peduncles about 1″ in terminal racemes, or few also axillary. Capsule sub-globose to oblong, 1–1·75″, densely covered with yellowish spreading hairs, obtuse or cuspidate at tip. Bracteoles 10–15, filiform, very persistent, ·75–1·75″, with dense spreading stiff hairs.

In forests, especially in the hills. Champaran! Throughout Chota Nagpur, common! Santal Parganas! Sambalpur!

Fl. Aug.–Nov. Fr. Oct.–Jan. It dies down after flowering.

Root fusiform. Branches often procumbent. L. orbicular, deeply cordate and subentire, or 3–5-angled or lobed (but not half way down) or sagittate with very long linear oblong auricles, densely softly hairy or villous and often with bristles on the nerves above, hairy and with stellate bristles beneath. Racemes from few to several, and dense-flowered, with filiform, 2–several persistent bracts at the base of the short peduncles. Capsules hirsute inside and out. Seeds sub-reniform, grey-brown, ·12″, glabrous, with curved lines of minute tubercles.

There are several forms :

α. Capsules ovoid, 1–1·25″, bracteoles much exceeding the capsules.

β. Capsules oblong, 1·25–1·75″, often much longer than the bracteoles.

γ. Abelmoschoides. Branches glabrescent, L. cut into 3–5 narrow, lanceolate, or linear segments. Peduncles up to 1·3″, bracteoles much shorter than the capsules and capsule somewhat glabrescent. Kodarma! Neterhat! This passes into the next species.

The root is eaten.

2. **H. abelmoschus,** *L.* Mushkdana, *H., Beng.*

A hirsute or hispid herb with polymorphous leaves, often resembling varieties of the last, large yellow flowers with peduncles 2–3″ long, usually axillary, more rarely in few-flowered leafless racemes. Capsule oblong, 2–2·25″, beaked, with rather sparse adpressed stiff hairs, glabrescent. Bracteoles 8–10, linear, ·3–·7″, rarely more or longer, deciduous, not densely hairy.

A rare plant in Behar and Orissa. Hundrugagh (Ranchi), *Prain.** Fls. Aug.–Nov. Fr. Oct.–Jan. Hazaribagh, *C. B. Clarke* in *Kew Herb.* (Var. *sagittifolius*)!

L. often 3–5-lobed half-way down or more, lobes serrate, sometimes very narrow. Less hairy than the usual forms of *cancellatus*, hairs on the petioles and peduncles usually stiff and reflexed, a few stellate bristles on the leaves beneath. Peduncles clavate above in fruit. Seeds reniform striate (as in last), musky.

3. **H. esculentus,** *L.* Mindijinga, *K.*; Ramjinga, *S.*; Bindi, *H.*; Ochro; Lady's Fingers.

Stems stout, strict, erect, 3–7 ft., very bristly; leaves 6–10″ diam., orbicular, cordate, mostly 5–7-lobed and nerved, coarsely toothed, both surfaces hirsute. Petioles 6–12″. Stipules 1″, erect, linear-subulate. Peduncles ·5–·75″, much swollen above, with about 10 erect bracteoles, ·5–·7″. Flowers 2–3·5″ diam., axillary, pale yellow with purple centre. Capsule 5–10″, young succulent, ribbed pubescent.

Generally cultivated for its unripe fruits, which owing to their demulcent properties can be safely eaten in cases where other vegetables are interdicted.

* But I refer Prain's plant, labelled *H. Abelmoschus* in *Cal. Herb*, to var. *abelmoschoides* of *H. cancellatus*, which closely connects the two species. It is not in fruit. Peduncles very short, only ·5″, and at top of stem, bracteoles ·7–·9″, but less filiform than in typical *cancellatus*. It is best distinguished by the indumentum on the peduncle, which is as in *H. cancellatus*, *i.e.* a close persistent pubescence with longer stiffer hairs, while that of *H. abelmoschus* is of reflexed stiff hairs or bristles, soon deciduous. Clarke's specimen has a glabrous but small capsule and sagittate leaves. It is also doubtful.

4. **H. pungens,** *Roxb.*

A stout, erect, scarcely branched herb, 6–12 ft. high, with bristly stem, palmately deeply-lobed or angled hairy leaves, 5–12″ diam., and large yellow flowers, 4–5″ diam., in terminal racemes. Bracteoles 4–5, broadly lanceolate, shorter than the large oblong, 2·25–2·75″ long, hirsute capsule.

Humid valleys of Singbhum, Porahat and the Santal Parganas! Not common. Palamau (Pendra Valley, Neterhat)! Purneah! Fls. July–Oct. Fr. Nov.–Dec.

Stem hollow, often black or purple spotted. Lower L. 5–7 lobed, often deeply, and lobes coarsely toothed or serrate, upper 3-partite, serrate, hairy above, with scattered stellate hairs beneath. Lower petioles exceeding the blade. Raceme often 15″. Bracteoles connate at base. Seeds black, striate, with curved, most minutely pubescent lines.

The Pendra Valley plant has reflexed bristles and 6–7 bracteoles, and is smaller than the type.

5. **H. tetraphyllus,** *Roxb.*

A herb or undershrub, branched from the base, with a thick tap-root. Branches with few short, hispid or prickly hairs, and deeply-lobed leaves with sparse, stellate (3-forked), hispid hairs beneath and very few above. Flowers primrose-yellow, 2·5–3″ diam. Bracteoles 4–5, ovate, lanceolate or ovate-lanceolate. Capsule under 2″.

Ravines in the Santal Parganas, on rocks. Fls. Oct.–Nov. Fr. Dec.–Jan. Perennial.

About 3 ft. high only. L. radical attain 8″ diam., lobed more than half-way down, cauline usually about 3–4″ diam., deeply or shallowly lobed; lobes usually 3 or 4 large and 2 smaller basal ones, elliptical or oblong, acute or cuspidate, sometimes again lobed, coarsely toothed. Petiole as long or three-fourths as long as the leaf. Stipules linear, ·5–·75″. Fls. axillary and in short terminal racemes with the bract-like stipules. Bracteoles persistent, ·62–·75″. Capsule oblong, 1·25–1·5″, beaked, covered with glandular and pungent hairs, 5-valved. Seeds black, striate, with rows of minute raised dots, striations with thin brown hairs.

6. **H. ficulneus,** *L.* Ran bhendi, *H.*; Naita, *Ho.*

A branched herb, 3–4 ft., with large tap-root and stems scabrous with tubercle-based setæ or nearly smooth. Leaves sub-orbicular, upper deeply 3–5-lobed, with the rounded lobes constricted at their base. Flowers white to pink with darker eye in more or less leafless racemes, 1–1·5″ diam. Seeds striate, with thin brown hairs.

Santal Parganas as an escape from cultivation! Cultivated in Chota Nagpur! and Behar (*Prain*). Not seen wild. Fls. Sep.–Nov. Fr. Nov.–Jan.

L. somewhat hispidly hairy, not stellate, variable from lobed to partite. Stipules caducous. Peduncles 1″, swollen above. Bracteoles short, linear, caducous (lanceolate, *Masters*). Capsule ovoid, 1·25–1·5″. covered with glandular and pungent hairs when green.

The plant yields an excellent fibre.

7. **H. Solandra,** *L'Her.*

Herbaceous, 2–3 ft., with cordate, ovate or sub-orbicular leaves, membranous, coarsely toothed, lower usually simple, upper usually with three acuminate lobes or 3-sect. Flowers small, ·5–·75″ diam., white, arranged in loose, terminal racemes on long pedicels. Bracteoles usually 0. Capsules slightly exceeding the ·3″ long calyx, somewhat pubescent, 5-valved, cuspidate, sutures ciliate with bristles.

Barasand Forest, Palamau! Fls. Sept.–Oct. Fr. Oct.–Nov. Annual.

8. **H. hirtus,** *L.* Syn. H. phœniceus, *Roxb.*

Suffruticose with herbaceous branches, ovate, strongly serrate leaves, 1–3″, often with a gland on the mid-rib beneath and pretty red or white flowers, 1″ diam., with spreading corolla and 5–7 subulate bracteoles. Peduncles and calyx with strong hairs and leaves stellately hairy beneath. Capsule globose.

Fls. Aug.

I have only seen it wild in the Central Provinces. Said to be frequent in Behar (*Prain*), probably as an escape from gardens.

9. **H. micranthus,** *L.*

A lax, weedy-looking undershrub, 3–6 ft., with slender erect branches, scabrid with stellate scattered bristles, and small ovate leaves, ·5–1″ long. Flowers ·5″ diam., axillary, white or pink, with corolla often reflexed. Capsule globose.

Chota Nagpur, not common! Puri, fairly common (Khandgiri sandstones! Baruni Hill forest, etc.!).

Fls., Fr. Sept.–April (April–Sept.?)

L. crenate or toothed, simple or 3-lobed, with stiff stellate hairs. Stipules filiform, ·1–·16″. Peduncles long, slender, articulate, far exceeding the leaves, usually on short lateral branches.

10. **H. furcatus,** *Roxb.* Piri-Pirika, *Or.*

An erect or trailing, suffruticose herb, 2–4 ft., with pungent, reflexed setæ on branches and petioles, and simple hairy undivided and 3-lobed leaves, 2–3·5″ diam. Flowers axillary and upper becoming sub-racemose, distant, with 10–12 setose forked bracteoles; outer lobe ovate-lanceolate, shorter than the linear inner lobe. Capsule ·5″, beaked, covered with rigid deciduous hairs.

Chota Nagpur (Horhap Forest! Pitorea, *Wood*); Puri (Chandka Forest! Rampur Forest!) Fls. Sept.–Nov. Fr. Nov.–Dec. Annual.

Setæ prickly, with bulbous base, often red. L. rarely 5-lobed, crenate-dentate or crenate-serrate, softly hairy, except on the hispid nerves. Stipules ·5″, linear-lanceolate. Peduncles ·2–·25″. Sepals 5, erect, lanceolate, rigidly acuminate, 3-nerved, densely clothed with tubercle-based setæ, persistent and closing over the fruit, often red. Corolla 2″ (4″, *Masters*).

11. **H. Sabdariffa,** *L.* Arhaipila, *Ho.*; Arharjorjora, *M.*; Arak Kudrum, *S.*; Kudrung, *Uran*; Patwa, *H.*; The Rozelle; Red Sorrel.

Erect glabrous with often simple ovate leaves, especially below, but mostly deeply 3-lobed with the mid-lobe broadest, 3-nerved, rarely some 5-lobed, lobes dentate or serrate, acuminate. Stems and petioles often red, petioles about as long as leaf. Fls. yellow, 2·5″. Bracteoles 8–10, linear, accrescent to the calyx, which is red and fleshy (or in one variety green) and usually muricate or setose.

Widely cultivated. Fls. r.s. Fr. Jan.

The calyces are made into a jelly, and the leaves are eaten.

12. **H. cannabinus,** *L.* Kudrung, *H., S.*; Dare kudrum, *S.*; Tepa, Kudrun Dora, *Uran*; Ji, Kotle, *K.*

A tall unbranched annual, 4–6 ft., rather prickly with bristles, large, very variable leaves, the lower usually entire and cordate, and the upper deeply 3–7-palmatifid, uppermost often entire lanceolate and curved on long slender petioles, all serrate. Flowers 3–4″ diam.,

white or pale yellow with purple eye, axillary, sub-sessile. Calyx campanulate, tuberculate, with 5 large sessile glands.

Widely cultivated in Behar, Santal Parganas and Chota Nagpur as an accessory crop. Fls. Oct.

A very distinct species. Native of Africa. Mid-rib of leaf with a gland beneath. Stipules linear. Bracteoles 7-10, shorter than calyx, which has an appressed white tomentum and tubercled hairs. Sepals long, acuminate. Capsule globose, bristly.

Yields a very valuable fibre known as Bimlipatam jute, quoted in Dec., 1916, at £35 per ton.

13. **H. vitifolius,** *L.*

A straggling, weak, suffruticose herb, 3–7 ft. high, hoary or grey tomentose or villous, without bristles, with simple or deeply acuminately-lobed, long-stalked, ovate dentate leaves and yellow flowers, 1·5–2·5″ diam., with purple eye. Bracteoles 6–12, linear, nearly free to base. Calyx large, with broadly lanceolate sepals. Easily distinguished in fruit by the winged, reticulately-veined carpels, which resemble those of a Pavonia.

Not very common, but distributed from Muzafferpur! to Angul! Manbhum, *Campbell*! In valley forests in Angul!

Fls. Oct.–Dec., and also found in flower up to March in cool localities. Fr. Nov.–March.

Lower L. usually 4-5″ diam., with 3 large acuminate lobes and rounded cordate base, uppermost ovate to lanceolate, all more or less dentate, pubescent and with long stellate hairs. Petiole as long as the blade. Fls. axillary and sub-racemose with peduncles 1–1·5″. Capsule short, sub-orbicular, 5-winged.

14. **H. panduræformis,** *Burm.*

A very tall herb, 10–12 ft. Stems pubescent and with pungent hairs. Lower leaves ovate and lobed, upper oblong-lanceolate, all coarsely irregularly toothed. Flowers solitary, axillary and sub-terminal, 1–1·25″ diam., yellow with purple eye, on very short (·25–·33″), stout, articulate peduncles. Ovary and capsule densely silky.

Waste ground, Palamau and Hazaribagh (near the boundary), rare! Fls. and Fr. Nov.–Jan.

L. hoary-tomentose both sides. Petioles 1–·15″, thickened above. Stipules and bracts filiform, caducous. Bracteoles 8, united into cup at base, linear-spathulate, adpressed to and much shorter than the calyx, which has oblong, acute, 3-nerved lobes. Seeds about 10 in each cell, brown, densely pubescent.

15. **H. collinus,** *Roxb.*

A small tree up to 3 ft. girth with leaves somewhat resembling those of a Maple, 4–6·5″ long and broad, deeply 3-lobed, with shallow-cordate base. Flowers 2–3″ diam., pink with dark centre. Capsule 1–1·3″ diam., oblate, cuspidate, yellow tomentose and densely setose.

Hills, Mals of Puri! Fl. r.s.? Fr. April.

Bark pale and greenish, blaze somewhat hard, light. Shoots tomentose and twigs hoary with stellate hairs. Leaf sometimes 5-lobed, hairy beneath and thinly so above, hairs simple and stellate, lobes acuminate or caudate, sinuate-dentate or sub-lobed. Primary nerves 5-7 and secondary raised beneath. Petioles 3-4·5″. Peduncles 3-4·5, axillary, jointed about ·6–·7″ from top. Bracteoles 5 (8-10, *Masters*). Calyx-lobes lanceolate. Capsule 5-celled and -angled, loculi with long bristles within. Seeds grey-black, sub-globose, ·16″ diam., glabrous.

Bark gives a fibre.

16. **H. tiliaceus,** *L.* Syn. H. tortuosus, *Roxb.*; Baniah, *Or.*; Bola, *Beng.*

A small much-branched tree, with orbicular cordate leaves, hoary beneath, 2–4″ diam. (4–5″, *F.B.I.*), and terminal, solitary or sub-panicled campanulate flowers, 3–4″ diam., yellow with crimson eye. Capsule ovoid, closely tomentose, and with tufted scales, 5-valved, with the endocarp inflexed at the margins of the valves and making it 10-celled.

Tidal forests. Cuttack, Mahanadi delta. Very common! Balasore (Chandpur)! Fls. Mar.–April. Fr. April–May.* Evergreen.

Branched usually close to the ground. L. with a short cusp closely stellate beneath, minutely crenate. Petioles 1–1·5″. Stipules ·5″, falcately oblong. Bracteoles 7–10, lanceolate, connate for half their length. Sepals twice as long, ·7″, lanceolate about as long as the capsule. Seeds black, glabrous, with pale dots.

Bark gives a strong fibre.

17. **H. mutabilis,** *L.* Thalpadma, *Beng.*

A large shrub or small tree, with leaves 4–9″ long and broad, deeply cordate, 3–5 lobed, sub-tomentose beneath, lobes crenate, midlobe long acuminate. Flowers white or pink, 5″ diam. from the upper axils, and sub-corymbose at the ends of the shoots.

Frequent in gardens. Fls. Sept.–Oct. Fr. Oct.–Nov. Deciduous.

The Fls. are usually double, open white and turn pink, but this is *not* always the case, and in some varieties they are pink from the first. Capsule sub-globose, ·8″ diam., hirsute, endocarp with dense white hairs. Seeds brown, densely bearded on the side away from the raphe.

It is a native of China (*Roxburgh*), but even the double flowers seed freely in this country.

18. **H. rosa-sinensis,** *L.* Common garden Hibiscus; Chinese Shoe-flower.

A well-known ornamental shrub. L. 2·5–3″, ovate, acuminate, coarsely serrate, sometimes lobed, glabrous and shining, base 3-nerved. Stipules ensiform. It includes very numerous single and double varieties, varying from very large brilliant crimson fls., often 5·5″ diam., through red to salmon-coloured and yellow fls. Fls. from the upper axils, all agreeing in the linear-lanceolate, bracteoles connate at base and shorter than the calyx; campanulate calyx cut about half way down into 5 lanceolate lobes which close over the oblong fruit.

This attains ·75″ in length, but never seems to ripen, and the seeds are abortive. It flowers practically all the year round. The Fls. were used at one time for blacking shoes (f. Roxburgh).

19. **H. syriacus,** *L.* Gurhul, *Vern.*

Usually of taller and more slender habit than the last, with upright branches. L. sub-rhomboid, often 3-lobed, dentate or coarsely crenate, nearly or quite glabrous, about 2″ long, with very short petiole. Stipules filiform. Fls. axillary, usually lilac with a purple eye. Bracteoles 6–8, linear.

Common in gardens.

20. **H. schizopetalus,** *Hook. f.*

Sarmentose, with narrowly ovate or sub-rhomboidally elliptic shining L., 2–3·5″, 3-5-nerved at base, crenate-serrate except at base, with minute, subulate, caducous stipules. Fls. axillary, drooping and fuchsia-like, on long slender jointed peduncles. Bracteoles about 7, minute subulate. Calyx spathaceous and 2-lobed, ·7″. Petals scarlet, deeply laciniate and reflexed. Staminal column long, filiform, pendulous. Style branches long.

Common in gardens, and a very distinct species. Native of Africa.

* According to *Roxburgh* it Fls. Mar.–May, and seed ripens three to four months afterwards. Early in May, however, I found ripe seed and no flowers, and apparently it flowers sporadically most of the year.

9. THESPESIA, *Corr.*

Trees or shrubs with entire or lobed leaves. Flowers large, axillary or terminal, sometimes in few flowered panicles. Bracteoles 5–8, deciduous. Distinguished from *Hibiscus* by the styles being connate into a 5-furrowed club-shaped entire or 5-toothed column.

1. **T. populnea,** *Corr.* Pares, Paras-pipal, *Beng.*; Habali, *Or.*; The Portia Tree.

A small tree with roundish or ovate, cordate acuminate, entire glabrous leaves 3–5″ long, and with long petioles. Flowers 2–3″ diam., yellow, fading to pink or purplish, often on peduncles 2–3″ long. Capsule globose, 1″ diam., drooping, black when ripe, 5-valved, but not opening widely.

Wild in the delta of the Mahanadi, Cuttack! Often planted by roadsides, etc. Fls., Fr. all the year round, but chiefly in the r.s. and c.s.

Young shoots scaly. L. coriaceous, 5–7-nerved, with small peltate scales when young; axils of principal nerves glandular.

NOTE.—*Roxburgh* makes two species of this tree—*Hibiscus populneus* and *Hibiscus populneoides*. The former, he says, has not glands in the axils and a single integument to the capsule, while the latter has a double integument to the capsule. I have not examined these characters in the field.

2. **T. lampas,** *Dalz. & Gibs.* Reke, *Ho.*; Bir Katsom, *K.*, *S.*; Ban-Kapsi or Ban-Kapus, *Beng.*

A stout undershrub, 4–6 ft. high, with palmately 3-lobed or entire leaves, 4–5″ diam., and terminal solitary or 2–3-nate large yellow flowers, 4–5″ diam., with crimson centre. Capsule 3–5-valved, girt at the base by the calyx-tube.

Very common in the forests throughout the area. Perennial and deciduous, or often dying down to the root and shooting out again with the May storms. Fls. Aug.–Oct. Fr. Oct.–Dec.

Young parts covered with brown tomentum. L. softly pubescent beneath, hairy above, base cordate or rounded, mid-rib with a gland near the base beneath. Peduncle swollen above, with 4–8 subulate or setaceous deciduous bracteoles.

There are two varieties:

α. Upper L. usually simple. Capsules 4–5-valved, globose, woody, only slightly dehiscent. The common form in our area.

β. L. all broad and 3-lobed. Capsule oblong or ovoid cuspidate, often only 3-valved, less woody, much more widely dehiscent, and more resembling that of a *Hibiscus*. Sambalpur!

It yields a strong fibre. The root and Fr. given in gonorrhœa. *Camp.*

10. GOSSYPIUM, *L.**

Tall herbs, shrubs or small trees, with 3–9-lobed more rarely entire leaves, and large yellow or purple flowers, with 3 large cordate bracts, which, as well sometimes as the leaves and other parts, are

* For this genus I have closely adhered to Sir George Watt's arrangement in the *Wild and Cultivated Cottons of the World*, 1907. I have also consulted Mr. G. A. Gammie's *Indian Cottons* in the Memoirs of the Department of Agriculture in India, vol. ii., September 2nd, 1907. Mr. Gammie's views differ radically from those of Sir G. Watt, and in my endeavour to give his synonymy I may not always have been successful. The vernacular generic names for all cottons are *Kapas* (for the plant), *Rui* (for the floss), *H.*; Katsom, Kaskom, *K.*, *S.* but each variety has its vernacular name.

often nigro-punctate, incised, toothed or entire. Calyx truncate or shortly 5-toothed. Ovary 5-locular. Style clavate at the apex, with 5 furrows and 5 stigmas. Capsule loculicidal. Seeds sub-globose or angular, densely woolly. Cotyledons strongly folded with auricles at the base enclosing the radicle, sometimes with black glands (like the bracteoles).

There are usually two coats on the seed, an inner short pubescence or hairiness known as the *fuzz*, and the outer adherent or easily removable floss or cotton. The capsules are called *bolls*.

I. Bracteoles united. Seeds with a fuzz.
- *a.* L. two-thirds palmately 3–7-lobed, base cordate, mid-rib only with a gland.
  - L. glabrescent, smooth, bracteoles entire or slightly toothed. Fls. purple . . . . 1. *arboreum.*
  - L. broader, bracteoles gashed . . . . var. *sanguinea.*
  - L. pubescent or hairy, bracteoles entire or toothed, Fls. yellow, with purple claw or purple flush . . . var. *neglecta.*
  - L. rough, lowest lobes somewhat reflexed and shorter, Fls. relatively small with purple claws, white or yellow, or with pink tinge . . . . var. *rosea.*
- *b.* L. half palmately 3–5-lobed; when 5-lobed usually broader than long, base not or scarcely cordate, gland on 1–3 ribs.
  - L. pilose, lobes ovate-oblong, almost obtuse, bracteoles large, purple, acute, with usually 3 teeth. Fls. yellow 2. *nanking.*
  - L. thin, softly pilose, lobes undulate, bracteoles large, purple, entire, or with a few pointed teeth, Fls. yellow with purple base . . . . var. *bani.*

II. Bracteoles quite free. Seeds with a fuzz.
  - L. hirsute. Bracteoles pectinate . . . . . . 3. *hirsutum.*

III. Bracteoles free, or nearly so, with conspicuous glands. Seeds without a fuzz.
  - L. nearly glabrous, half or more segmented into 3–5 spreading oblong acuminate lobes . . . . . 4. *barbadense.*

1. G. arboreum, *L.*

A small tree or large shrub with very slender, often purple, almost glabrous branches, except that the younger parts are more or less woolly. Leaves firm, smooth, cordate, 5–7-lobed two thirds of the way down, lobes oblong-lanceolate, often with small, supplementary teeth in the sinuses, apex with minute bristles, midrib with a gland. Flowers few on short abortive shoots, bracteoles rather small, usually entire, purple-green. Flowers large, deep, shining, purple. Seeds with greenish-grey fuzz, cotton adhering, white, silky.

Not found, except as an ornamental garden plant in our area, but *Watt* considers the following varieties derived from it, and states that when grown as a field crop it may become bushy and annual. Those hybrids characterised by hardiness, soft silky flosses, and which often throw back to purple flowers, he considers possess strains of this stock.

Probably a native of Africa, *Watt*; but it is the cotton which Brahmins select for preparing the sacred thread.

Var. *α* sanguinea, *Watt.* Syn. G. sanguineum (*Gammie*, loc. cit.).

A red-flowered field cotton. Capsule almost linear. Fuzz less green and more grey.

Bengal, *Buch., Hamilton*, who stated that it occurred everywhere in his time. It is now rare (if it occurs at all) in our area.
Fls. late and does not bear cotton till the hot weather.

Var. β **neglecta**, *Watt*. Syn. G. herbaceum, *F.B.I.* (in part); G. intermedium, *Tod.* (*Gammie*, in part?); and G. neglectum, *Tod.* (*Gammie*, var. vera); Deshila, Deshi, Jethi, *Beng.*; Deshi Kapas, *Or.*; Kherdya (Ranchi); Bengal Cotton; Kharia kapa (Mayurbhanj?).

A pyramidal bush from 1·5″–3·5 ft. high with often reddish stems. Leaves somewhat coriaceous, lobes often furrowed and corrugated, 3–7, with supplementary lobules in the sinuses, linear-lanceolate, lowest pair patent or reflexed, acute, hairy and stellately tomentose. Flowers 2–4 on short lateral shoots or (in my specimens) sometimes solitary, yellow with purple centre or yellow or white with a purple tinge, usually campanulate. Bracteoles ovate, acute, toothed, half or more the length of the corolla. Boll ovate, acuminate, 3–4-celled. Seeds with brownish or greenish fuzz and much coarse woolly, short-stapled cotton.

The commonest cotton of the province, especially on jhumed lands in jungle districts! Fls. Jan.

It is an inferior but easily grown cotton.

NOTE.—*G. intermedium*, according to the report of the Cotton Specialist (1909-10), is represented by two forms in Bengal, one *Deshila* with small bolls, which is probably this species, and the other *Bhogila*, with larger bolls, which is probably *G. nanking, Meyen.* They are grown as a mixture with Rahar in North Behar.

Var. γ **rosea.** Syn. G. neglectum, *Tod.*, var. rosea (*Gammie*); Nurdki, *Beng.*; Varadi Cotton.

Leaves deeply palmatipartite with narrow lobes. Flowers very short, erect, white, or white-yellow with a pink tinge, bracteoles as long as the corolla.

Said to be grown in Bengal and I think in our area, but have seen no herbarium specimens. It is a very inferior cotton according to *Watt.*

2. **G. nanking,** *Meyen*. Syn. G. intermedium (*Gammie* in part?); G. neglectum, var. vera, sub-var. kokatia, *Gammie* (probably); Chinese Cotton.

Leaves often glabrescent above and pale green, usually very wide, broader than long, with scarcely any cordature at the base.

Var. α **bani,** *Watt*. Jethi, Deshi (Behar); Bhogla, *Beng.*; Bhoga kaskom, *S.* (is probably this); Berar Cotton.

A bush with sparsely-branched stems which, with the petioles, are purplish below the numerous spreading hairs, young twigs, petioles, L. and peduncles, also with close, short, adpressed, stellate hairs. L. hairy, coriaceous, and often glabrescent with age, very conspicuously gland-dotted, three prominent ribs with large glands beneath, usually 5-lobed, 1·5–2·75″, very broad and often broader than long, lobes broadly-oblong or ovate-oblong, acute or suddenly cuspidate, the outermost usually small, arching upwards from the usually very shallowly cordate base. Petiole as long as blade. Stipules narrow, linear-acuminate, but upper broad and unequal, one oblique and toothed, the other linear. Fls. mostly solitary, axillary, bright yellow with purple spots on the base, pinkish in bud and after maturity. Bracteoles large, ·9–1·5″, purple, with few apical or also several marginal long-pointed teeth, deeply cordate, auricled. Capsule somewhat angled, ovate acuminate, 3-4-celled. Seeds large, irregular, densely coated with rufous velvety fuzz and with a good silky white or khaki floss.

N. Behar, *Gammie* (see note above); South Bihar, *Ham.*! Manbhum, largely cultivated, *Campbell* (if the *Bhoga Kaskom* is this).

3. **G. hirsutum,** *L.* = G. hirsutum, *Mill.* (*Gammie*); Budhi, Burhi, *Vern.*; Upland Georgian Cotton.

A coarse, stunted, rounded bush, much branched, yellowish-green or greenish-red, usually covered with dust from the character of the numerous hairs on the shoots, petioles and leaf-veins. Leaves rather thin, 3-lobed (sometimes simple to 5-lobed), lobes short, triangular, with straight margins. Base rounded, cordate. Bracteoles rounded, 1·3–1·6″, with numerous caudate teeth, terminal often very long. Flowers light yellow without a dark eye (though this is present in Miller's type, *teste Watt*). Bolls large, spherical, usually 4-celled. Seeds large, ovate, truncate one end and with a pronounced greyish, rusty or green fuzz. Cotton white.

Singbhum, at Chaibassa! Manbhum, *Camp.*; Mayurbhanj (probably the Budhi cotton referred to by *Cobden Ramsay* in *The Gazetteer*). Fls. Dec.

"Appears to have adapted itself admirably to the natural conditions of the higher lands of Bengal," *Gammie.*

This cotton was well spoken of by the Cotton Specialist in his report for 1907. It is an early maturing variety.

4. **G. barbadense,** *L.*

Sub-arboreous. Branches angled above, dotted. Flowers very large, 2·5–3″ long, with large pectinate bracteoles half as long, teeth finely acuminate.

Cultivated in Bengal, *Prain.* I have only seen isolated plants.

11. KYDIA, *Roxb.*

Trees with stellate pubescence and palminerved, usually lobed leaves. Flowers panicled, polygamous, with 4–6 bracteoles connate at the base, spreading accrescent in fruit. Staminal tube divided to about the middle into 5 arms, each bearing 3–4 anthers, which are imperfect in some flowers. Ovary 2–3-celled, style deeply 3-cleft with peltate stigmas, imperfect in some flowers. Ovules 2 in each cell, ascending. Capsule sub-globose, loculicidally 3-valved. Seeds reniform, furrowed.

1. **K. calycina,** *Roxb.* Bita-goinr, *K.*; Poska Olat, S.; Derki, *Kharw.*; Pula, Baranga, *H.*; Patar, *Th.*; Ban Kopasia, *Or.*; Bur Kapa, *Gond.*; Pola, Jara Baranda, *Vern.*

A moderate-sized tree or flowering as a shrub, very handsome when bearing its pure white, large panicles of flowers, ·75″ diam. Leaves sub-orbicular, palmately 5–7-nerved, stellate pubescent or tomentose, and always with a large gland on 1–3 of the nerves beneath. Bracteoles ·25–·5″ in fruit, oblong or oblong-spathulate.

Throughout the province in valleys and on hill slopes. Fls. Sept.–Nov. Fr. Dec.–May. Deciduous March.

Bark pale. Blaze white, faintly pink at the margins. L. 4–6″ diam., sinuate, angled or somewhat lobed, with strong parallel secondary nerves. Petioles 2–3″. Petals obcordate, very long clawed, densely pubescent (at least in the shrubby form). Capsule small, enclosed in the calyx, mealy with stellate hairs. Seeds one in each cell, brown.

The wood is scarcely used. The tree coppices freely and grows fast and might sometimes be useful as a nurse.

12. BOMBAX, *L.* Silk-Cotton Tree.

Trees, often very large and sometimes with verticillate branches. Leaves digitate. Flowers very large, solitary or clustered Bracteoles 0. Calyx leathery, capsular. Stamens in 5 groups, opposite the petals, anthers reniform, 1-celled. Ovary 5-celled, style clavate, stigmas 5. Ovules many. Capsule loculicidally 5-valved, valves woolly within. Seeds woolly.

1. **B. malabaricum,** *DC.* Edel, *K.*, *S.*; Simal, *H.*; Simli, Simuri, *Vern.*; The Red Silk-cotton Tree.

A large tree with a prickly trunk and branches when young, 5–7-digitate leaves and large scarlet flowers, which mostly appear when the tree is leafless. Capsule ovoid, 5–7″.

Throughout the area, attaining its largest size in cool valleys. Fls. Jan.–March. Fr. March–May. Leafless Dec.–March or even to April.

Attains 12 ft. girth and more above the large buttresses to the stem in favourable situations. Bark white. Blaze thick, soft, dark pink, streaked with pale pink and white.

The first leaves of the seedling are simple, ovate, acuminate; these are followed by 3-foliolate leaves. Cotyledons expand and are broadly ovate, ·8″, 3–5-nerved with petiole ·1″. The tree is very easily grown from seed and easily transplanted. I have done this successfully in the cold season. It is used for the "jamots" of wells in Hazaribagh (*Thomson*), and is often sawn into planks for cheap, light boxes. If badly stored it soon discolours, with a very bad smell. Immersion in water improves its durability. The growth is very rapid.

Gamble gives the weight as varying from 17–32 lbs. The cotton is used for stuffing pillows, razais, etc. "From its trunk proceeds an exudation called Mochras, much used by the natives in diarrhœa; when dry it is dark brown." *Ham.*

13. ADANSONIA, *L.*

1. **Adansonia digitata,** *L.* The Baobab.

A moderate-sized tree with a very swollen trunk, smooth bark and widely spreading branches. Leaves resembling those of a Bombax, digitate, with 5 sub-sessile, obovate, cuspidate leaflets. Flowers very large, 6–7″ diam., white, pendulous, on long peduncles. Calyx leathery, gamosepalous below. Staminal tube naked below, the free ends of the stamens forming a large truncately globose head, 2–2·5″ diam. Ovary 5–10-celled. Fruit large, gourd-like.

Sometimes planted. Several trees near the Dorunda Bridge, Ranchi. Fls. April–June. Fr. Aug.–Oct. Native of Africa.

Kew Bulletin 8 of 1916 records the use of these trees as water reservoirs in Kordofan.

FAM. 27. STERCULIACEÆ.

Herbs, shrubs or trees, with the general characters of Malvaceæ, but flowers often 1-sexual or polygamous, with often a tendency to irregularity; petals sometimes 0, stamens sometimes definite and anther cells always 2, parallel or divergent. Ovary sessile or stipitate, of 2–5 carpels loosely united and follicular in fruit, or connate into as many cells and fruit capsular, rarely carpel 1 (*Waltheria*). Ovules anatropous.

I. Fls. 1-sexual or polygamous. Petals 0. Anthers in a ring on a column.
  A. Anthers many. Fruiting carpels dehiscent . . . 1. *Sterculia.*
  B. Anthers 5. Fruiting carpels indehiscent . . . 2. *Heritiera.*
II. Fls. 2-sexual. Petals present, without long appendages.
  A. Anthers in a ring on the top of a column.
    Fls. panicled. Capsule bladdery . . . . . . 3. *Kleinhovia.*
    Fls. axillary, moderate-sized, irregular. Capsule elongate, sub-follicular . . . . 4. *Helicteres.*
    Fls. axillary, large, regular. Capsule large, woody . 5. *Pterospermum.*
  B. Anthers on an antheriferous tube, often with long filaments, numerous . . . . 6. *Eriolæna.*
  C. Anthers on the margin only of tube, 15 only, in groups alternating with staminodes . . . . . . 7. *Pentapetes.*
  D. Stamens 5, only tubular below.
    Ovary 5-celled . . . . 8. *Melochia.*
    Ovary 1-celled (of one carpel) . . . . 9. *Waltheria.*
III. Fls. 2-sexual. Petals curiously shaped and often with long appendages.
    Fls large, 2″ . . . . 10. *Abroma.*
    Fls. very small. Anthers grouped between staminodes . . . . 11. *Guazuma.*
    Fls. very small. Anthers solitary between staminodes . . . . 12. *Buettneria.*

1. STERCULIA, *L.*

Trees or shrubs with simple, palmate or digitate leaves, palmately-nerved. Flowers polygamous, panicled. Calyx tubular, lobed, often coloured. Petals 0. Stamens united into a column bearing a head or ring of sessile anthers. Ovary of 4–5 carpels, opposite the sepals. Styles connate at the base, stigmas radiating. Fruit of distinct follicles, woody or membranous. Seeds in each follicle 1–many, sometimes arilled or winged. Cotyledons flat and thin, adhering to the albumen, or thick and fleshy. Germination epigeal.

1. L. digitate . . . . 1. *fœtida.*
2. L. mostly cut into 5 or 7 acute or acuminate lobes, villous or tomentose beneath when young. Capsules woody.
  Leaf lobes usually simple. Bark greenish or white, papery . . 2. *urens.*
  Leaf lobes usually again 3-lobed. Bark not papery. Panicles rusty . . . . 3. *villosa.*
3. L. mostly 3-lobed (rarely simple in old, or 5-7-lobed in very young trees). Capsules membranous.
  Fls. scarlet. L. glabrescent . . . . 4. *colorata.*
  Fls. yellow. L. tomentose (even when old) . . . . . 5. *fulgens.*
4. L. simple, entire, glabrous . . . . 6. *alata.*

1. S. fœtida, *L.* Badam, *Vern.*

A straight tree, much resembling a Simal (Bombax), with very stout twigs and leaves crowded at their ends with 7–9 elliptical or elliptic-lanceolate, acuminate leaflets, smaller 4″, larger 6–7″ (on same leaf). Panicles many, sub-terminal, 4–6″ long from below the opening leaves bearing numerous racemes of green or purplish flowers, densely woolly within. Follicles scarlet, 3–3·5″ long, very stout, ultimately woody, recurved and boat-shaped.

Rather widely planted. Jharsuguda, Sambalpur (*Mudaliar*). Purulia station! Gaya station! Ranchi station! Found on Parasnath according to Anderson. Fls. March. Fr. ripens following Feb. Deciduous. New L. appearing just after the flowering.

Bark smooth. L. distinguishable from those of a *Simal* by the very short petiolules, which are only ·2″ long. Leaflets coriaceous with 14–20 prominent spreading secondary nerves. Young viscid-glandular with unpleasant smell. Petioles 5–9″.

Calyx 5-fid, lobes ·4-·5″, lanceolate. Column long, curved, hairy. Anthers whorled. Seeds slate-coloured, ellipsoid, oblong, ·6-·7″, with rudimentary yellow aril, epidermis thin and inner testa brown, coriaceous.

In the seedling there is a massive hairy and glandular hypocotyl and large oblong cotyledons, 1-1·5″, with many basal nerves and very broad petioles. The first leaves are digitately 3-4-foliolate.

The seeds are eaten and have a taste of filberts. They are usually roasted. The raw seeds are said to bring on nausea and vertigo (*I.P. & D.*).

2. **S. urens,** *Roxb.* Teley, *K.*, Telhec', *S.*; Kaunji, *Kharw.*; Keunji, *Uran.*; Kulu, Gulu, *H.*; Gendule, *Khond.*; Girungila, *Or.*

A large or moderate-sized tree with thin papery bark which appears white in the distance, and gaunt spreading branches marked with large scars. Leaves 5-lobed, tomentose glabrescent beneath with entire lobes. Panicles 4-7″, densely viscidly pubescent. Flowers ·16″ diam. Follicles pungent with bristles.

A conspicuous feature of the dry rocky hills of the hill country south of the Ganges, extending to Sambalpur, Angul and Puri ! Especially common in the dry hills of Chota Nagpur but rarer in the Santal Parganas ! Gaya Ghats ! Ascends to 3000 ft. at Neterhat ! Not seen north of the Ganges.

Fls. Dec.-Feb. Fr. April. It drops its leaves in Nov. or Dec. and often remains leafless until the May storms.

Outer bark very thin with chlorophyll beneath it. L. 9-16″ both ways, not deeply lobed (never half way down), but usually broadly 5-cuspidate, base deeply cordate, rounded. Petiole 6-12″. Fls. reddish-brown, tomentose outside, green inside the oblong acute lobes, which are bearded within at the base and crimson inside the tube.

It yields a gum, "Katila," used by the Santals in throat affections (*Camp.*). The seeds are eaten. The bark yields a fibre. *Gamble* says "wood very soft, reddish-brown, with an unpleasant smell, used to make native guitars and toys." It used sometimes to be cut into planks in the C.P. Weight 42 lb.

3. **S. villosa,** *Roxb.* Sisi, *K.*; Ganjher, *S.*; Walkom, Pironja, *M.*?; Sisir, *Oraon*; Udal, *Kharw.*, *H.*; Baringa, *Gond.*; Chop, *Th.*; Kodalo, *Or.*

A large tree with grey or brown, often pale, but not papery outer bark. Branches with large leaf scars. Leaves deeply 5-7-lobed, tomentose beneath, lobes again 3-lobed, rarely entire. Panicles pendulous, 9-12″, rusty, pubescent. Flowers ·5″ diam., membranous. Ripe follicles tomentose, scarlet inside.

Essentially a tree of the valleys as *S. urens* is of the exposed hills. On both sides of the Gangetic valley and throughout the whole province, but nowhere abundant. Found on cool sides of hills, *e.g.* Parasnath (Hazaribagh) ! Meghasani (Mayurbhanj) ! Neterhat, 3000 ft. !

Fls. Jan.-March. Fr. May-June. Leafless Dec.-May.

Blaze hard, red or crimson. L. adpressed, villosely-tomentose beneath, 9-16″ both ways, usually cut to the middle, base deeply cordate, lobes caudate or again 3-partite. Petiole as long as leaf. Fls. ·5″ diam., yellowish with pink centre. Seeds several, brown with a black shining aril, ·3-·5″.

A very strong fibre is obtained from the bast, which accounts for the scarcity of the tree in some places. The wood is now used for tea boxes in the Duars; it is a very bad fuel. The tree coppices freely; the seeds germinate soon after falling in June.

"Growth fast, 3-6 rings per inch of radius. Weight 15-22 lb." *Gamble.*

4. **S. colorata,** *Roxb.* Sisi, *K.*; Udal, *S.*; Sisir, *Uran*; Kodalo, *Or.*; Pani Kodal (Angul), *Or.*

A large or moderate-sized tree, very beautiful in flower, when the numerous panicles resemble masses of scarlet coral. In fruit it is

easily distinguished by the very membranous green or rosy follicles which open widely, bearing one seed on one or both of the margins.

Widely distributed throughout the province. Attains 6 ft. girth in the Ramnagar forests (N. Champaran)! Valley and cool sides of hills in Chota Nagpur, frequent! Kodarma! Not specifically noted from Sambalpur. Angul, frequent! Mayurbhanj! Bonai, *Grieve*. Fls. March-April. Fr. April-May. Leafless Jan.-May.

Bark grey or brown, roughish. Blaze rather thick, pale, with streaks of cream and yellow or yellow in old trees. L. 6-12″, with only scattered stellate hairs beneath. In young plants very deeply 7-lobed or partite, in old trees usually with only 3 caudate lobes and deeply caudate base. Fls. ·75″, clavate, orange-scarlet, stellately tomentose, with pedicels and rachis of panicle of the same colour.

Yields a strong fibre. "Growth fast, 3 to 4 rings per inch of radius." *Gamble*.

5. **S. pallens,** *Wall.** Syn. S. pallens, *Wall.*; S. fulgens, *F.B.I.* (in part); Phap, *Th.*

A moderate-sized or very large tree with nearly smooth grey bark and a dense crown of broadly orbicular-oblong leaves, 6-10″ wide, rather broader than long, cordate, and with 3 terminal lobes, persistently softly velvety beneath with dense stellate hairs and with shorter more sparse stellate hairs above. Flowers resembling those of *S. colorata*, but yellow instead of scarlet. Follicles membranous, opening before maturity.

Bettiah and Ramnagar forests from the foot of the hills up to 2000 ft.! Fls., Fr. h.s. Deciduous h.s.

This, which is usually described as a small tree, attains 8 ft. in girth and fully 60 ft. in height, but it is often forked or slightly buttressed below. Bark with small exfoliations in large trees. Blaze white with a little green and yellow. L. with 7-9 principal nerves. Petiole 6-12″, stellately tomentose. Fls. ·5-·8″, buds globose, calyx campanulate, yellow tomentose, lobes ovate or lanceolate acute.

The wood is said to resemble that of the Simal. "Weight, 31 lb." *Gamble*.

6. **S. alata,** *Roxb.*

A tall, large tree, with smooth grey bark and a dense somewhat narrow crown of large, simple, cordate, ovate or broadly oblong, quite entire, 7-9-nerved leaves 4-10″ long. Flowers in simple or compound racemes from the axils of fallen leaves, green and yellow, tomentose outside, inside streaked and dotted purple.

Rather extensively planted as an ornamental tree, and although a native of the damp forests of the Duars, Assam and Chittagong, it succeeds well in quite dry localities. Ranchi Station! Chaibassa-Chakradharpur Road, etc., etc.!

Fls. March-June, both before and with the L. Fr. Nov. Deciduous Feb.-March.

Young parts only with rusty stellate hairs or scales. Racemes 2-5″. Fls. campanulate with unpleasant smell. Sepals 5-6, ·7-·8″. Anthers in male fls. about 5 in a ring at top of column, in Herm, fls. in 5 sessile groups in the sinuses formed by the carpels. Follicles large, woody, sub-globose, 4-5″. Seeds winged, cotyledons not separable from the albumen.

2. HERITIERA, *Aiton.*

Trees with coriaceous leaves, closely covered with minute flat scales beneath. Flowers small or very small, 1-sexual, in lateral panicles. Calyx 5- (4-6-) toothed or -cleft. Petals 0. Stamens united into a column with anthers in a ring at the top. Carpels 5-6, almost free, style short, stigmas 5, thick, ovule 1 in each carpel. Fruit of woody indehiscent, 1-seeded, keeled or winged carpels. Cotyledons thick, fleshy. Albumen 0.

* First described by *King* in *Journal of As. Society*, lx, ii, 73.

1. **H. minor,** *Roxb.* Syn. H. Fomes, *F.B.I.*; Sundri, *Or.*, *Beng.*

A small tree with brown branches and narrow elliptic leaves, 2·5–5″ (4–6″, *F.B.I.*), silvery-scaly beneath like an *Elæagnus*, entire and penninerved with about 6–9 secondary nerves faintly looping inside the margin. Flowers pinkish or orange, campanulate, ·15–·18″ long, with 4–5 triangular lobes, males very caducous. Fruit (ripe carpels) 1·5″ diam.

Mahanadi delta in tidal forests! The well-known Sundri of the Sunderbans. Fls. Jan.–May. Fr. August.

Roots with pneumatophores. Branchlets scaly, scales with a minute rust-coloured centre. L. with tapering acute or rounded base, and obtuse rounded or sub-acute apex, *not* acuminate. Usually 2 very slender secondary nerves from base. Petiole stout, ·3–·8″. Panicles short, lax, pubescent, 1–2·5″. Ripe carpels, roughly resembling two unequal sphere segments, placed face to face with a rim at their line of junction, an oblique keel on the lower (or inner face) ending in the scar of attachment, and a larger keel on the upper (or outer) face or segment.

I have picked up the Fr. from the beach at Puri!

3. KLEINHOVIA, *L.*

1. **K. hospita,** *L.*

A small tree with smooth bark, broadly ovate or sub-orbicular leaves with retuse or cordate 7-nerved base, acuminate, glabrous, 4–5″ (or 6–12″ in luxuriant specimens, *Roxb.*), with strong cross tertiary nerves and long petiole. Flowers about ·7″ diam., pink, in ample terminal panicles. Sepals 5, nearly free, narrow oblong, ·32″, tomentose. Petals 5, zygomorphic, posterior sub-tubular. Stamens on a gonophore in a ring round the apex, which is cupular and 5-cleft, each division with 3 anthers. Ovary tomentose, 5-celled. Capsule loculicidal, membranous, inflated, 5-winged, each cell with 1 black seed.

Often planted. There is a small avenue of it at Daltonganj. Native of the Moluccas according to *Roxburgh*. Fls. Oct. Fr. Dec.

4. HELICTERES, *L.*

Trees or shrubs. Leaves simple. Flowers axillary, often zygomorphic. Calyx tubular, 5-fid. Petals 5, claws often auricled. Staminal column adnate to the gynophore, 5-toothed, with anthers in groups between the teeth; anther cells divergent. Ovary 5-lobed and -celled, ovules many. Fruit sub-follicular, sometimes follicles spirally twisted. Seeds tubercled. Cotyledons leafy, folded round the radicle. Albumen scanty.

1. **H. isora,** *L.* Poto-porla, sinkari, *K.*; also called Goinr from a confusion with *Grewia*; Petcamra, *S.*; Aitem, aita, *Kharw.*; Murad, Maraphal, *H.*; Muri-muri, Murmuria, *Or.*; Pita Baranda, *Khond.*

A shrub or small tree with oblique usually cordate, broadly oblong or rounded, pubescent, 5–7-palmi-nerved leaves, scarlet lateral zygomorphic flowers, 1·5″ long, and a woody fruit of 5 spirally rolled carpels on a very elongated gynophore, tardily follicular when ripe, and dehiscent along their inner edge.

Distributed throughout the whole province from Champaran southwards. Very common and often gregarious both in the valleys and especially on northern aspects in the hills. Fls. April–Dec. Fr. Oct.–Jan., but the open carpels may be found up to June. Deciduous in March and renews leaves in April.

Shoots softly villous. L. rarely symmetrical, bifarious, 3-6″, often scabrous above, densely stellate pubescent beneath, often somewhat lobed, serrate. Petiole ·25-·5″. Peduncles axillary or extra axillary, 2-4 together, short. Calyx ·5-·75″, oblique, stellate. Petals reflexed.

The root, bark and fruit are given for colic. Powdered and fried in ghee and sweetened it is used for bowel complaints in various districts—possibly a case of the Law of Signatures, the use being suggested by the shape of the fruit.

5. PTEROSPERMUM, *Schreb.*

Trees or shrubs lepidote or with stellate hairs. Leaves usually oblique, simple or lobed. Flowers large, axillary and terminal, bracteoles sometimes laciniate. Sepals 5, more or less connate. Petals 5. Staminal column short, with 5 forked or 5 pairs of staminodes, and 3 slender stamens with linear anthers between each or each pair. Ovary inserted within the top of the column, 3–5-celled, style 1, with 5-furrowed stigma, ovules many. Fruit a woody capsule, loculicidally 5-valved. Seeds winged above, 2-seriate in the inner angle of the cells. Cotyledons plaited or corrugate. Albumen thin or 0.

L. very broad, 7-12-nerved. Fls. 4-5″ . . . . 1. *acerifolium.*
L. oblong-acuminate, 4-5-nerved. Fls. 3-4″ . . . . . . 2. *Heyneanum.*
L. oblong-lanceolate, 5-7-nerved, with a large basal auricle . 3. *semisagittatum.*
L. oblong, 3-5-nerved. Fls. 1-1·5″ . . . . 4. *suberifolium.*

1. **P. acerifolium,** *Willd.* Muchu kundi, *K.*; Machkunda, *S.*; Machkan, *Th.*

A large, handsome tree with large palmately-nerved cordate leaves, white tomentose beneath, and large fragrant white flowers. Capsule oblong, woody, 5-valved.

Indigenous in the Ramnagar hills (N. Champaran), but rare! Doubtfully indigenous elsewhere. Messrs. Campbell and Watt believe it to be so in the Tundi forest. It is commonly planted near villages throughout the area. The name "Muchokunda" is Sanscrit and is also the Hindi and Bengalee name for *P. suberifolium*, Lam.

Fls. March–July. The capsules open at the time of flowering in the following year. Evergreen.

Rusty tomentose. L. 6-15″, lobed, entire or coarsely toothed. Fls. regular or sub-regular. Sepals 4-5. Petals 3·5-4·5″, linear-oblanceolate. Stamens 15, shorter than the staminodes, with filiform filaments and linear anthers. Staminodes 5, 3·4-3·75″ long (including tube), pubescent, filiform, slightly clavate. Capsule rough.

2. **P. Heyneanum,** *Wall.* Giringa, rarely Machkunda, *Or.*

A handsome small tree with oblong repand, coarsely dentate or lobed, rarely entire leaves, 3-6·5″, white beneath between the raised brown nervation, base subcordate. Flowers pure white, fragrant, 3·5-4·5″ diam. Capsule 2-3″, oblong, but slightly narrowed upwards, and base suddenly acute.

Orissa, frequent, on sandstone and conglomerate in the Chandka forest in the plains, and also in the hill forests on metamorphic rocks in Puri! Mayurbhanj! Angul! Rare in Sambalpur (on the red shales in the Bargat nala)!
Fls. Oct.–Dec. Fr. April–May. Evergreen.

Twigs, petioles, nerves beneath, peduncles and sepals densely covered with rusty stellate hairs or scales. L. usually wider upwards and then suddenly acuminate or caudate, lobes or teeth usually very acute. Secondary nerves 5-8, of which 1 or 2 (each side) strong ones from the base, tertiaries scalariform. Petioles ·25-·4″. Bracteoles stipitate, 4-6, narrow elliptic to broadly cuneate, ·7″, irregularly toothed and gashed. Sepals linear, 1·7-2·5″, white villous within. Petals obliquely cuneate, with white stellate pubescence. Stamens filiform. Capsule obtusely 5-angled, rusty stellate-tomentose, apiculate. Seeds about 4-5 in each row, with broad wings.

3. **P. semisagittatum,** *Ham.*

A very handsome tree with large handsome flowers with broad petals. Easily recognised by the large auricle on one side only of the leaf base. Capsule terete.

It is sometimes planted in gardens. Fls. April-May.

4. **P. suberifolium,** *Lam.* Makai Champa (*teste Ham.*).

A handsome tree with the oblong leaves 2·5-4″ long, subregular, rounded or oblique, or subcordate at the 3-5-nerved base, never auricled, very hoary beneath. Flowers only 1-1·5″ diam. Capsule oblong terete, sometimes beaked, 2-2·5″.

Purneah, very rare, *Ham.* Found in Ganjam, and may be found wild in Orissa, where it is sometimes seen in gardens.

6. ERIOLÆNA, *D.C.*

Trees or shrubs with palmately-nerved leaves and regular yellow flowers, axillary or panicled, bracteolate. Calyx spathaceous, 5-toothed or partite. Staminal tube short with many anthers, cells parallel. Staminodes 0. Ovary sessile, 5-10-celled. Style with as many spreading stigmas as there are cells. Ovules many. Capsule woody loculicidal, axial angle of valves villous. Seeds winged above. The woody peduncles are often sharply flexed in fruit.

Bracteoles laciniate.
- Peduncles 1-flowered. Larger leaves 8-12″ . . . 1. *Wallichii.*
- Peduncles 1-few-flowered. Larger leaves 4-6″ . . . 2. *Hookeriana.*

Bracteoles entire or lobed.
- Flowers sometimes panicled. Larger leaves 3-4″ . . 3. *quinquelocularis.*

1. **E. Wallichii,** *D.C.*

A large stout shrub or small tree, with ovate or broadly orbicular, cordate-based leaves of very variable size, mostly about 8″ each way, irregularly crenate, with acute or obtuse apex, rugulose and thinly hairy above, permanently shortly stellate beneath, with very prominent raised nervation. Peduncles 1-flowered, stellately pubescent. Sepals ·8-1·2″ long, lanceolate acuminate. Capsules oblong ellipsoid, 1·25-1·5″, with apex rounded apiculate, about 8-valved, stellately scurfy, nearly smooth.

Sandstone hills, Ramnagar forests! Fls. r.s. Fr. Nov.-Dec.
Shoots shaggily tomentose. L. when in flower 3-6″ long, mature ovate, and sometimes only 3″ at the base of the shoots, attaining 12-14″, and orbicular-ovate on the same branch or individual; young densely tomentose beneath, mature hoary between the rusty stellate-pubescent nerves, base deeply or shallowly cordate with 7 primary nerves. Petioles 1-3″, never quite glabrescent, stout on the larger leaves. Bracteoles pinnatisect. Fls. 2-5″ diam. Sepals densely stellate-tomentose outside, villous within. Petals orbicular. Column glabrous. Seeds 7-9 in each cell, with a broad scimitar-shaped wing.

2. **E. Hookeriana,** *W. & A.* Bundum, Uidbulung, Hakehomo, *K.*; Ganguli, *S.*; Ponra, *Uran*; Bonta, *Or.*

A shrub or small tree with the new shoots densely stellately scaly, leaves 3–6″, orbicular, cordate acuminate, white or grey tomentose beneath, more or less glabrescent. Flowers yellow, 1·5–2″ diam. 1-few on axillary or extra-axillary long peduncles. Sepals ·6–·8″. Capsule ovoid, corrugate or tubercled.

Hill tracts south of the Ganges from Shahabad and the Santal Parganas to Sambalpur and Angul! Probably also in Puri, but not noted.

Fls. April–June. Fr. Nov.–Jan. Deciduous. New leaves at time of flowering. L. toothed or crenate, often with alternately round and smaller triangular teeth, mature usually entirely covered beneath with thin stellate tomentum, glabrescent above, base 5–7-nerved; petiole 1–2·5″, rather stout. Bracteoles laciniate, pinnatisect, ·3–·5″, usually deciduous after the flower opens. Buds ovoid, beaked by the tips of the valvate tomentose sepals. Sepals as in *E. Wallichii*, but smaller, and spreading more directly from the base. Capsule usually 8–10-valved, about 1″ long.

Var. **viridis.**

L. green beneath with minute, distant, stellate hairs only; petiole slender. Capsule 6-valved, closely covered with yellowish-green felt, broadly ovoid and apiculate and nearly smooth. Orissa!

This may be an undescribed species, but without Fls. it is not possible to describe.

The wood of *E. Hookeriana* is strong and used for axe handles. The bark is said to yield a good fibre.

3. **E. quinquelocularis,** *Wight.*

A small tree much like the last, easily distinguished in flower by the slender 2–5-flowered peduncles, and minute very caducous, entire or only lobed bracteoles, and in fruit by the less tubercled narrow capsules, 1–1·25″ long, lanceolate in outline and sharply pointed. In leaf it is very similar, but the under surface is white and more thinly stellate and the petioles relatively longer, being often as long as the blade.

Behar 1–4000 ft. (Parasnath), *J. D. H.*, but I have seen no undoubted specimens from our area; that marked *E. quinquelocularis* in the *Cal. Herb.* I regard as *E. Hookeriana.*

NOTE.—Two other species of *Eriolæna* are recorded from Behar and Orissa in the *Cal. Herb.*, viz.:

4. **E. Stocksii,** *H. f. & T. T.*

Rajmahal Hills, *Kurz.*; Manbhum, *Campbell.*

The specimens appear to be distinguished from *E. Hookeriana*, *W. & A.*, by the very narrowly ovoid buds, much longer than the laciniate bracteoles, and by the stellate tomentum on the underside of leaves being thinner. It seems to me a variety of *E. Hookeriana.*

5. **E. spectabilis,** *Planch.*

Behar, 1–4000 ft., *J. D. H.*

This is only a leaf specimen with a broken capsule, with valves 1″ long and tubercled. It might be *E. Hookeriana.*

7. PENTAPETES, *L.*

Flowers axillary, with 3 caducous bracteoles. Sepals 5, lanceolate persistent, connate at base. Petals 5. Stamens 20, in 5 groups of 3 each, alternating with 5 staminodes, which are nearly as long as the

petals. Ovary 3–5-celled, cells many-ovuled. Capsule loculicidal. Seeds 8–12, 2-seriate in each cell. Cotyledons plaited, 2-partite.

1. **P. phœnicea,** *L.* Bare baha, *S.*

A pretty branched herb, 2–5 ft. high, glabrous, or with a few scattered hairs, easily recognised by its long, lanceolate, sharply toothed or crenate-serrate leaves, 3–5″ long, with only 1 primary nerve. Flowers large, red, nodding on short 2-flowered peduncles. Sepals stellate and bristly. Capsule sub-globose, bristly, axis woolly. Seeds sub-globose, dotted.

In wet places, not common. Purneah! Santal Parganas, *Wood.* Fls. Aug.–Oct. Fr. Nov.–Dec. The root is used medicinally, *Camp.*

8. MELOCHIA, *L.*

Herbs or undershrubs more or less pubescent. Flowers small, clustered or panicled. Petals spathulate, marcescent. Stamens 5, connate below. Ovary 5-celled, cells 2-ovuled. Capsule loculicidal. Embryo straight, cotyledons flat.

1. **M. corchorifolia,** *L.* Thuiak', *S.*

An undershrub with oblong-ovate serrate plaited leaves, 1–3″ long, with rounded or cordate base. Flowers small, white or pink, collected in dense heads. Calyx tube ·12″, surrounded by 4–5 bracteoles ·25–·33″ long. Capsule depressed globose, pubescent, 5-grooved.

Common in waste places, bunds of rice fields, etc. Fls. and Fr. r.s. The L. are eaten as a vegetable and the stem yields a fibre.

9. WALTHERIA, *L.*

Herbs or undershrubs. Flowers small, clustered. Petals oblong-spathulate. Stamens 5, tubular below. Ovary 1-celled, ovules 2. Capsule 2-valved, 1-seeded. Embryo straight, cotyledons flat.

1. **W. indica,** *L.*

A perennial, hoary-tomentose undershrub, 2–4 ft., partially dying down in some situations, and shooting out again in May and June. Leaves velvety, ovate or ovate-oblong, sub-plicate, toothed, with 5-nerved base, larger, 2·8″ by 1·12″, rarely 3″ long. Flowers yellow or pink, in axillary, sessile, or stalked dense capitate cymes, with small lanceolate bracts, and also running out into leafless spikes. Petals ·16–·25″, narrow oblong, with a long claw. Staminal tube with 5 oblong anthers without staminodes. Capsule ·08″, ovoid, villous, 2-valved, with 1 black seed.

Especially on rocks in open dry jungles, also common in waste land. Fls. r.s.

Abroma augusta, *L.*

A large shrub with cordate, ovate-oblong leaves, 4–6″, and large purplish-yellow flowers; is occasionally seen in Indian gardens. It yields a good fibre.

11. GUAZUMA, *Plum.*

A stellately tomentose or pubescent tree with small flowers in axillary cymes. Sepals 5, nearly free, sometimes two or more coherent in pairs. Petals 5, clawed, hooded, and apex terminating in two slender ligulate appendages. Staminal tube with 5 lanceolate lobes (staminodes ?), alternating with 5 groups of 3 fertile anthers, nearly sessile, on a short knobbed filament. Ovary 5-lobed and 5-celled, sunk in the staminal tube. Ovules numerous. Fruit oblong, woody tubercled. Seeds many, albuminous, 2-seriate, embryo curved, cotyledons leafy folded.

1. G. tomentosa, *Kunth.*

A moderate-sized tree with lanceolate or oblong-lanceolate, often falcate, very obliquely cordate-based acuminate serrulate leaves 2–4·5″, which are closely covered with stellate hairs both sides, those on upper surface very short. Base 3–7-nerved. Petioles ·2–·3″. Flowers yellow. Sepals ·15″, stellate tomentose. Seeds ovoid, grey.

Often planted. Manbhum, *Campb. Herb.* ! Very common in Cuttack station ! where it grows into a fairly large tree, and is sometimes called "Bastard cedar." Fls. April–July. Fr. Feb.–June.

The fruit, though capsular in appearance and deeply 5-grooved, is not dehiscent. It remains on the tree and falls at the next flowering period.

12. BUETTNERIA, *L.*

Trees, shrubs or herbs, sometimes climbing, with simple, entire or toothed leaves. Flowers purplish, small or minute, cymose, cymes often umbellate and panicled. Petals with a hooded base and variously shaped horns or appendages. Staminal tube short, with 3 fertile anthers and 5 staminodes. Ovary 5-celled, cells 2-ovuled. Capsule globose, more or less echinate, septifragally 5-valved. Cells 1-seeded. Albumen 0. Cotyledons folded round the radicle, plumule lobed.

1. B. herbacea, *Roxb.* Idel sanga, *K.*; Deku sindur, *S.*

A branched herb with a perennial woody rootstock, distant ovate-lanceolate, acuminate, toothed leaves 1–2·5″ long, and axillary cymes of small purplish flowers, remarkable for the long slender tips and 2-fid appendages of the petals. Capsule softly spiny, ·25″ diameter.

Throughout the hill area south of the Ganges, chiefly on rocky ground in the forests. Fls. June–Oct.

The rootstock is ground and rubbed on swellings of the legs by the Kols. It is also used in combination with Bael fruit, hesel gum and Banyan root in cholera and diarrhœa. "It is given in the female complaint, known in Santali as Jordhol," *Camp.*

2. B. aspera, *Colebr.*

A large woody climber with large, cordate, sub-orbicular or oblong leaves, with 6 basal nerves, and the minute flowers in axillary, hoary cymose panicles.

Rajmahal Hills, *Prain.* Fls. May–June.

I rather doubt this plant being now a native of the province. It is described as

a tree in the *F.B.I.* and *Bengal Plants*, but all the herb sheets I have seen which bear remarks as to its habit describe it as scandent. I am unable to find any specimens from the Rajmahal Hills or elsewhere from B. & O. either at Calcutta or at Kew. The flora of those hills has, however, become terribly impoverished within the last fifty years.

FAM. 28. TILIACEÆ.

Trees, shrubs or herbs, with the general characters of Malvaceæ but leaves rarely deeply lobed, flowers often small without an epicalyx. Sepals 3–5, usually free. Petals as many, rarely 0, free, usually imbricate. Stamens (sometimes few in *Triumfetta* and *Corchorus*), free, or sometimes 5-adelphous, but not united into a tube, often on a gonophore; anthers 2-celled. Ovary 2–10-celled. Ovules anatropous. Fruit various, often drupaceous or deeply lobed. Seeds 1 to many, exarillate, usually albuminous. Embryo straight or slightly curved.

1. Small trees, shrubs or herbs. Anthers opening by slits, usually very short.
   - A. Sepals connate below. Anthers subglobose. Small tree or shrub, scaly . . . . 1. *Brownlowia.*
   - B. Sepals free.
     - Herbs or undershrubs. Fr. small, dry, echinate . . 2. *Triumfetta.*
     - Herbs. Fr. capsular, not echinate . . . . . 3. *Corchorus.*
     - Trees or shrubs. Fr. drupaceous with 1–4 pyrenes . . 4. *Grewia.*
2. Trees. Anthers opening by terminal pores, linear. Petals incised. Fruit drupaceous . . . . . . 5. *Elæocarpus.*

1. BROWNLOWIA, *Roxb.*

Trees or shrubs with scaly or stellate indumentum. Leaves entire with 1–2 secondary nerves from near the base. Flowers small, in terminal and lateral panicles. Calyx campanulate, 3–5-cleft. Petals 4–7. Stamens many, united at base into 5–7 bundles, filaments free. Staminodes 5–7, within the stamens, ligulate or petaloid. Anthers subglobose. Ovary of 4–5 nearly free carpels. Ovules 2 in each cell, collateral. Styles long, free or coherent. Fruit sub-follicular, follicles 2-valved, 1-seeded. Albumen 0. Cotyledons thick, fleshy.

1. **B. lanceolata,** *Benth.*

A small tree or shrub with lepidote twigs, narrow lanceolate acuminate leaves, 4–6″ long, whitish, scarcely silvery beneath, and small flesh-coloured 2-sexual flowers, in short axillary and terminal cymes, covered with brownish scales.

Tidal forests of the Mahanadi Delta, common ! Fls. May–June.

L. closely lepidote beneath, lateral basal nerves oblique, very slender and short, other secondary nerves spreading, fine, scarcely distinguishable from the reticulate intermediate. Petioles ·3–·4″. Cymes ·5–1·5″. Calyx ·15–·2″ long, cleft about half-way down, lobes obtuse, lepidote. Petals scarcely clawed, narrowly obovate, ·25–·27″. Torus scarcely elongated. Staminodes linear or linear-lanceolate, ·1–·15″, sometimes with rudimentary anthers. Follicles (very old) coriaceous, ·4″, wides at top, truncate.

2. TRIUMFETTA, *L.*

Herbs, undershrubs or shrubs, with simple, serrate or lobed leaves and small yellow flowers in dense cymes or fascicles, which are axillary or run out into interrupted spikes or racemes. Stamens

8–15, on a fleshy glandular torus. Ovary 2–5-celled, ovules 2 in each cell. Style filiform, stigma 5-toothed. Fruit with spines or bristles, usually hooked, indehiscent or tardily dehiscent. Seeds 1–2 in each cell.

Flowers open in evening and remain open till following morning, rarely during mid-day.

1. L. lanceolate or ovate-lanceolate, tapering at apex.
   - Shrubby. Fr. densely hairy, spines with patent hairs . 1. *pilosa*.
   - Herbaceous. Fr. glabrous, spines glabrous or with few hairs 2. *annua*.
2. L., some or all orbicular, apex rounded or 3-lobed.
   - A. L. hairy, but not tomentose beneath, open lobed.
     - Herbaceous. Spines of fruit hispid-ciliate . . . 3. *neglecta*.
     - Herbaceous or suffruticose. Spines glabrous . . . 4. *rhomboidea*.
   - B. L. white, tomentose beneath, not lobed . . . . 5. *rotundifolia*.

1. T. pilosa, *Roxb.*

A shrub, 3–6 ft. high, with stellate-hairy stems, and simple, ovate-lanceolate, subcordate leaves, softly stellate-hairy both sides. Conspicuous in fruit from the heads of hooked spines, ·75–1″ diam., including the ·25–·3″ long hairy spines.

Shady moist woods in Singbhum and Palamau!
Fls. Sept.–Nov. Fr. Nov.–Jan.
The flowers open in the evening.
Stellate hairs on stem with red bulbous bases. L. attain 6″ by 2·75″, pale and densely hairy beneath. Petiole ·5–2″. Stipules ·25″. Sepals ·3–·4″, linear, stellate-hairy, apiculate. Petals linear-oblong or oblanceolate, ·25″, spreading. Stamens 10. Fr. 4-celled, 8-seeded.

2. T. annua, *L.*

A herb with the stems and branches usually pubescent on one side only; leaves smaller than in *T. pilosa*, and often more ovate and glabrescent, except for a few hairs on the nerves beneath. Fruiting heads smaller and quite glabrous between the spines, which are glabrous or ciliate.

Behar, *Kurz*!
It is a species of moist regions and the Behar specimen was probably from Purneah.

3. T. neglecta, *W. & A.*

A herb often flowering when 4″ high, but attaining 2 ft., when it closely resembles *rhomboidea* with the leaves ovate or rhomboid, simple and 3-lobed, densely stellate-hairy beneath. Fruits ellipsoid, pubescent, with the spines hispid-bearded, usually on one side only, straight, or some hooked.

Frequent in Chota Nagpur, Singbhum! Hazaribagh!
Fls., Fr. Sept.–Dec.
Fls. sometimes found open in the afternoon. It is perhaps scarcely more than a variety of the next species.

4. T. rhomboidea, *Jacq.* Chikti, *H.*

A stouter herb than the last, or an undershrub, 3–4 ft., with more or less pubescent branches, and mostly 3-lobed, 5–7-nerved leaves, hairy beneath, but simple hairs usually predominating. Fruits

ellipsoid or subglobose, ·25″ diam., including the minutely-hooked glabrous spines.

Very common everywhere, attaining its largest size in damp shady places. Fls., Fr. Oct.-Jan.

Stems usually more pubescent on one side. Lower L. with rounded bases attaining 5·5″ long and broad, 3-lobed and coarsely toothed, with a petiole up to 4″ long; upper L. gradually smaller and uppermost lanceolate. Fls. fascicled, axillary and running into terminal spikes. Sepals linear, ·17-2″, apiculate. Petals oblong or spathulate, somewhat shorter.

Yields a soft glossy fibre. Mucilaginous.

5. **T. rotundifolia,** *Lam.*

An undershrub, 3-4 ft. high, with sub-orbicular, scarcely lobed leaves, ·5-1·5″ diam, white tomentose beneath. Fruits globose or ellipsoid, ·2-·25″ long, including the small hooked spines.

Open waste ground, in dry places. Western districts of the northern area only. Behar, *Kurz*! Fls., Fr. Sept.-Dec.

3. CORCHORUS, *L.*

Herbs or undershrubs with simple leaves and small yellow flowers, on axillary or extra-axillary, often leaf-opposed peduncles. Stamens free, diplostemonous or indefinite, on a short gonophore. Ovary 2-6-celled, with short style and concave stigma. Capsule linear or globose, 2-5-valved, sometimes transversely septate. Seeds many, embyo curved.

A. Capsule globose. L. usually tailed . . . . 1. *capsularis.*
B. Capsule much longer than broad.
  1. Capsule without distinct horns or beaks.
    Stamens many, some or all the L. with a pair of tails near the base, capsule smooth . . . . 2. *olitorius.*
    Stamens many, L. rarely with basal tails, capsule rough . 3. *trilocularis.*
    Stamens 5-10. Capsule softly pubescent . . . . . 4. *fascicularis.*
  2. Capsule with 3 spreading or erect horns.
    Capsule 3-winged and 3-angled . . . . 5. *acutangulus.*
    Capsule terete . . . . 6. *tridens.*

1. **C. capsularis,** *L.* Pat Sanpat, *Vern.*; Kaskomrau, *S.*; Jute.

A herb 2-4 ft., or attaining 6-7 ft. in cultivation, with lanceolate or oblong acuminate, rarely ovate-lanceolate, serrate leaves, 1·5-3·5″, (or 3-6″ in cultivation) long. Base of leaves sometimes tailed as in the next species. Capsule depressed, globose, muricate, 5-valved.

Wild in most districts. In the forest at Betlah (*Palamau*)! Usually in the open. Manbhum, *Campbell*! Fls. r.s. Fr. Oct.

This appears to be the species most generally cultivated, but except in Purneah and parts of Orissa the rainfall is in general not sufficient for it, and it is nowhere grown on a large scale as in Eastern Bengal.

2. **C. olitorius,** *L.* Hatempa, *Ho.*; Bir narcha, *S.*; San-pat, *H.*; Jute.

A herb, in its wild form only 1-3 ft. high, taller in cultivation, with glabrous stems, elliptic to ovate, rarely ovate lanceolate leaves, 2-4″ long, serrate, and with two of the serratures near the base of some or all the leaves produced into long, very slender tails. Capsule usually 5-valved, 1·5-2·8″ long, glabrous or nearly so, angled, the tip usually 5-lobed but not horned, cells septate between the seeds.

A very common wild plant, occurring in open lands in all districts in the rains! but not widely cultivated in the province. The principal centres of cultivation are Purneah and parts of Orissa. In Mayurbhanj two varieties known as Sirajganji and Deshi Jute are grown. Fls., Fr. r.s., chiefly Sept.

L. nearly glabrous or hairy, base rounded, 5–6-nerved, secondary nerves 5–6, fine and distinct. Petiole ·75–2″. Stipules ·35–·45″, subulate, with filiform tips. Fls. 2–3, on a very short peduncle. The flower buds are broad, obovate, beaked with the sub-aristate tips of the petals. Young Fr. hispidulous.

The young plant is eaten as a vegetable.

3. C. trilocularis, *L.*

A herb with linear-lanceolate, linear-oblong, or more rarely elliptic-oblong leaves, ·75–3·5″, crenate-serrate, sometimes with slender basal tails, usually very pubescent. Petioles short but slender, ·25–·4″. Capsule very slender, 2–2·5″, scabrous, septate on the valves between the seeds, usually 3–4-valved.

Not common. Gaya! Parasnath! Fls., Fr. June–Oct.

4. C. fascicularis, *Lam.*

Suffruticose, 3 ft. high, with narrowly oblong or oblong-lanceolate leaves, ·5–2·3″, serrate or serrulate acute, and leaf opposed clusters of linear, densely pubescent, or pilose subterete capsules, ·5–·75″ long.

Singbhum! Saidope Forest, Palamau! Santal Parganas! Fl. r.s. Fr. Oct.–Nov.

Branches glabrous or with a few hispid hairs above. L. somewhat tapering to the 3-nerved base, nearly glabrous, with 5–10 oblique secondary nerves raised beneath. Petioles hispid on upper side, ·2–·3″. Stipules linear acuminate, ·15–·2″. Fls. ·17″ diam. Peduncle ·05″ in Fr., 3–5-flowered, sometimes lateral or sub-axillary. Pedicels hardly any. Capsules fascicled, shortly beaked, 3-celled, beak minutely 3-lobed. Seeds about 8 in each cell, ends truncated.

5. C. acutangulus, *Lam.*

A species more closely allied to *C. olitorius* than are the last two. Erect or diffuse with broadly-ovate to oblong-ovate leaves, ·7–2″, rarely 3″ long, with the base occasionally tailed as in *olitorius*. Capsule ·5–1″, 6-angled, of which 3 of the angles are alate or sub-alate, apex with 3–4 suberect or spreading beaks or horns.

Prefers shady places, and often found among rocks. Singbhum! Hazaribagh! Manbhum! Fl., Fr. r.s. to Nov. There appear to be two varieties.

α. Suberect with l. broadly ovate crenate, 1–3″, often rounded at apex. Petioles ·4–1″, hairy above.

β. Diffuse with lanceolate-ovate l. ·5–1·3″, crenate, serrate or serrulate, acute. Petiole ·2–·3″, hairy.

6. C. tridens, *L.*

Said to be found in Tirhut (*B.P.*). I have seen no specimens from our area. According to *F.B.I.* the L. are linear-oblong or lanceolate, 1–3″ by ·5–1″, with petiole ·17–·25″. Capsule 1–2″, cylindric, terminated by 3 spreading points.

4. GREWIA, *L.*

Trees, shrubs, or rarely undershrubs, with stellate pubescence, simple 3–7-basal-nerved, serrate or serrulate leaves and yellow or white flowers in axillary, sessile or stalked clusters or umbels, rarely panicled. Sepals free, often white or yellow within. Petals shorter than the sepals, usually with a large gland with a pubescent rim at

the base, or almost wholly reduced to a nectary.* Stamens hypogynous, usually on a short gonophore.* Ovary 2-4-celled. Style 1, with a more or less deeply-lobed stigma. Ovules 2-several in each cell. Fruit often lobed, of 1-4 pyrenes, enclosed in a succulent or ultimately fibrous mesocarp. Pyrenes 1-2-seeded. Seeds albuminous, with large, flat, thinly-fleshy cotyledons. Germination epigeal, cotyledons nearly nerveless, sub-sessile.

A. Fls. white, or sepals first white then becoming dull yellow inside. Shrubs (except sometimes 6 and 7). Gonophore usually with a cornice which is hirsute or densely ciliate.
  1. Climbing or straggling shrub. Fls. large, ·7–·8″ long, terminal and becoming leaf-opposed. . . . . 1. *rhamnifolia.*
  2. Erect (or straggling in 4). Fls. axillary.
    a. L. very broad. Fr. large, globose.
      Sepals ·25″–·3″. Fr. green or yellowish, coriaceous 2. *aspera.*
      Sepals ·5″–·7″. Fr. purple, epicarp finally crustaceous 3. *sclerophylla.*
    b. Straggling. L. oblong. Sepals ·3–·5″. Stigmas 4, linear spreading. Fr. stellately hairy . . . 4. *flavescens.*
    c. Erect shrubs or undershrubs. L. narrow or oblong. Sepals ·25–·3″ long. Stigmas capitate with radiating papillæ. Fr. depressed, more or less lobed.
      L. linear to oblong or oblong ovate. Peduncles very short . . . . 5. *hirsuta.*
      L. linear, white beneath. Peduncles slender . . *var. helicterifolia.*
    d. Trees or large shrubs. L. lanceolate or narrow elliptic. Fr. didymous or 4-lobed.
      L. 1·5-4″. Sepals ·2–·3″ long . . . . . . 6. *multiflora.*
      L. 3-9″. Sepals ·5–·6″ long . . . . 7. *disperma.*

B. Fls. bright yellow, always axillary. Gonophore present or absent, pubescent or tomentose above.
  1. Trees.
    a. L. ovate or oblong, very oblique or auricled, or cordate at base, glabrescent. Petioles over ·5″ long, slender. Stipules mostly falcate and auricled. Fr. didymous . . . . 8. *tiliæfolia.*
    b. L. ovate or oblong, rarely orbicular, oblique or subregular at base, persistently tomentose or hoary beneath, or if green, then petioles short, stout and tomentose. Fr. not didymous.
      Bark dark, rough. L. grey-green when adult. Petals ·2–·25″ . . . . 9. *rotundifolia.*
      Bark light, smooth. L. white, tomentose beneath. Petals under ·2″ . . . . 10. *elastica.*
      L. green beneath . . . . *var. vestita.*
    c. L. very broadly ovate or suborbicular, green beneath. Petioles stout. Peduncles long. Fr. purple, ·3–·5″ diam. . . . . 11. *Hainesiana.*
  2. Shrubs. Peduncles slender in all.
    L. orbicular, cuspidate, white beneath, not cuneate 12. *asiatica.*
    L. rounded at tip, mostly with cuneate base, green, rarely hoary beneath . . . . 13. *sapida.*
    L. lanceolate, always white beneath . . . . 14. *Rothii.*

1. **G. rhamnifolia,** *Heyne.* Syn. G. orientalis, *F.B.I.*

A large climbing shrub with leaves mostly 2·5-4″, pale green, ovate-lanceolate, acuminate, serrulate or crenulate, nearly glabrous. Flowers large with sepals ·7–·8″ long, white or yellowish in terminal

* The nectary may be present or absent in one and the same species, though apparently it is constantly present in some. Its presence or absence is usually correlated with the length of the gonophore, the latter being very short or absent when the nectary is absent.

and leaf-opposed, few-flowered umbels. Drupe ·5–·6″ diam., depressed, globose, faintly 2–4-lobed, hairy and yellow-tomentose.

Puri, in rocky forests! Fl. May–July. Fr. Sept.–Dec.

L. attain 5 by 2·2″, few stellate hairs beneath, base rounded or obtuse, 3-nerved, but sometimes with two small additional nerves, secondary nerves above basal 3–5. Petiole ·2″, densely stellate. Peduncles ·25–·4″, bracts linear, ·3″. Buds ovoid, strongly ribbed, tomentose and hirsute. Petals ·17″ Gonophore short, top 5-ridged. Style very stout, and stigma 4-lobed. Stones of fruit several-seeded. Pedicels in fruit stout, ·5–·7″ long.

2. **G. aspera,** *Roxb.* Syn. G. abutilifolia, *Indian Trees, F.B.I.* (?); G. sclerophylla, *F.C.N.*

A coarse bushy shrub, about 4 ft. high, rarely with long sarmentose branches, twigs densely stellate. Leaves large, roundish or broadly elliptic, often somewhat 3–4-lobed, serrate or denticulate, closely stellate-pubescent, especially beneath. Flowers ·5–·7″ diam., white in *sub-sessile* axillary umbels. Petals ·08–·1″ long. Fruit globose, ·75–1″ diam., with 2–4 rugose pyrenes.

Chota Nagpur, occasional: Singbhum, on wooded slopes! Manbhum, *Camp.* (under *G. villosa*)! Orissa: Khurda! Kuhuri Forest!

Fls. April–Aug. Fr. Sept.–Feb. More or less evergreen. Young L. appear with the Fls., or somewhat before.

Innovations very tomentose. L. about 3″ at time of flowering, attaining 4–8″, stellately scabrid above, base rounded with three strong and two weaker principal nerves, tertiaries strong, scalariform. Petioles ·5–1″, often slender. Pedicels ·1–1·5″. Fl. buds short ovoid, ·2″, densely stellate tomentose. Peduncles ·25″ or less. Sepals yellowish with age, ·3″–·4″. Petals with large gland, entire or notched. Gonophore long with hirsute tufts above. Ovary densely hirsute. Stigma stellately 4–5-lobed, the lobes deciduous, leaving it capitate.

N.B.—The old, dry fruit remains long on the branches. It is much shrunk in herbarium specimens, and usually described as only ·3–·5″ diam.

3. **G. sclerophylla,** *Roxb.* Syn. G. scabrophylla, *Roxb.*; Dapher, *Th.*; Phalsa, *Beng.*

A shrub or undershrub usually sending up many erect, strict, villosely-tomentose branches 3 ft. high, from a perennial woody stock with large elliptic, ovate or obovate leaves, 4–9″ long, densely stellately tomentose or villous beneath, and with very thick stout petioles. Flowers large, white, 2–3, umbelled on short peduncles. Fruit globose, ·7–·9″ diam., purple globose, ultimately with crustaceous rind, hairy.

Common in high grass lands, especially those fit for Sal, along the foot of the hills, Champaran! Fls. April–June. Fr. Oct.–Nov. Shoots, where I have seen it, annually burnt.

Much more softly and persistently hairy than in *G. aspera*, and habit different. L. with three very strong and usually two less strong basal nerves, venation much as in *aspera*, margin with small sub-glandular and hairy unequal teeth, upper surface rugulose, more or less glabrescent, hairs less stellate and scabrid than in *aspera*. Petiole ·3–·7″, mostly with some large glands at the top. Peduncles ·3–·5″. Sepals ·5–·7″, tomentose. Petals about half as long, obovate. Gonophore short or long, densely hirsute above. Stigma with four large lamelliform lobes. Hairs on fruit, though stellate, have the branches parallel, not radially spreading.

The fruit is eaten. It is said to be cooling.

4. **G. flavescens,** *Juss.* Syn. G. pilosa, *Lamk.* (*F.B.I.*, etc.).*

A large straggling shrub or sub-scandent, with sharply 3–4-angled

* *G. pilosa* is sometimes called a small tree. Our plant is *never* arboreous. A specimen in *Cal. Herb.* in bud called *G. pilosa* is *Guazuma tomentosa*.

stems. Branches, leaves and inflorescence hirsute, with stellate hairs, not villous. Leaves oblong or sometimes broader upwards, but suddenly narrowed at the tip or more rarely acuminate. Flower buds oblong, mostly constricted in the middle, ·3–·5″ long before opening. Stigmas 4, linear, spreading. Fruit closely covered with very *short* stellate hairs.

A rare plant in our area. Hazaribagh, Pachamba, *Camp.*! Parasnath, *Anderson.** Ranchi, *Wood*. Fls. July–Oct. Fr. Dec–Jan.

Easily distinguishable in flower, similar to some states of *hirsuta* in leaf, from which, however, it may be distinguished by the habit, the stiff not softly villous hairs on the branches and fruit, which break off with age, leaving a stellate base, also by the remarkable short medianly-constricted, terminally-dilated and cup-shaped gonophore, which is recognisable in fruit and after this has fallen.

L. 2″ by 1″ to 4″ by 1·5″, with rounded or subcordate base, often doubly serrulate. Secondary nerves 4–5. Petiole ·12″. Peduncles few, ·25″. Sepals ·5–·7″. Petals more than half as long, bifid. Anthers with a few long hairs. Ovary hirsute.

5. **G. hirsuta,** *Vanb.*, inc. G. helicterifolia, *Wall.* Syn. G. polygama,† *F.B.I.*, etc.; G. pilosa, *Roxb.*; Gursukri, *H.*, *Kharw.*; Kukur bicha, *H.*; Seta kata, seta andir, seta beli, *S.*, *K.*; Sonaranga, *Or.*

A shrub, usually 1·5–3 ft. high, with many stems from the root, tomentose or stellately villous all over, with leaves varying from linear to ovate-lanceolate or broadly oblong, serrulate, very shortly petioled, usually acuminate, stellate tomentose beneath and also closely stellate above when young. Flowers polygamous or diœcious, buds ovoid, under ·25″. Flowers depressed, more or less lobed, ·25–·4″ diam., yellow, pilose, with long deciduous hairs or (var. *helicterifolia* sometimes) nearly glabrous.

Throughout the whole province, chiefly in open forest, common. Fls. July–Sept. Fr. Nov.–Jan.

Very variable. The following forms occur:

α. G. hirsuta proper (*G. hirsuta, Roxb.*, and perhaps *G. pilosa, Roxb.*). L. lanceolate to ovate lanceolate, hoary or pale velvety and densely clothed with stellate and pilose-stellate hairs beneath; hairs deciduous above leaving a simple base (*cp. flavescens*). Peduncles few or clustered, equal to petiole. Pedicels as long. Fls. opening white, turning yellow, and finally brown.

Sepals ·25″ to nearly ·3″. Petals ·1–·14′, oblong entire, blade not much longer than the gland. Male gonophore cylindric, but slightly expanded into a sinuous cornice, the top of which is densely pilose. Stamens 45 or more, much longer than the hairs. Herm. fls., gonophore without a cornice, and hairs exceeding the stamens. Ovary hirsute. Fr. deeply 2-lobed, and each half slightly lobed. In fruit the hairs of the gonophore spread beneath it. Common.

β. polygama. L. large and rather membranous, often 4·5–5″ by 1·6″, green beneath, with 3–4-nerved base. Peduncles very short. Fr. scarcely lobed. A very distinct form. Palamau! Hazaribagh!

γ. **helicterifolia,** *Wall.* Syn. G. angustifolia, *Wall.*; G. polygama, *F.B.I.*, not *Roxb.*

Stems very slender, L. very narrow, white, with a very fine tomentum between

* The plant from Parasnath included under *G. flavescens* at Kew is not this in my opinion, but rather one of the numerous forms of *G. hirsuta*.

† *G. polygama, Roxb.*, is not the narrow-leaved shrub described under that name in the *F.B.I.*, and by others. Roxburgh's original drawing shows *broadly lanceolate* leaves and short peduncles. Nor can I follow the new determination of *G. polygama* in the *Flora of Madras*, as in my very complete series of these forms 3-nerved leaves are often on the same plant as slightly-lobed fruits and 4-nerved leaves with deeply-lobed fruits. Both breadth with its correlated number of basal nerves and depth of lobing of the fruit are very variable characters.

the raised nerves beneath, 2·5–4″ long, under ·75″ broad. Peduncles 1–4, slender, attaining 1·2″, but usually shorter. Male stamens about 30 only. Stamens in herm. fls. slightly exceeding the hairs. Fr. sometimes green and shining when young, smaller and without hairs, or with very short, delicate, stellate hairs, but at other times more as in type, usually subequally faintly 4-lobed above.

Ramnagar hills of N. Champaran (typical *helicterifolia*)! Scrub jungles in the west of Palamau (slightly more hirsute)! Many other forms may be found; even broad-leaved ones with long peduncles were collected by me in the Central Provinces.

The fruit of all varieties is pleasant eating, with a yellow or brown crustaceous rind when ripe. It is given in diarrhœa and dysentery. A decoction of the leaves is also said to be used.

6. **G. multiflora**, *Juss.* Syn. G. sepiaria, *Roxb.*; Pansaura, *H.*

A shrub or sometimes a tree with slender twigs, sparsely scabridly pubescent with forked hairs, broadly or narrowly lanceolate or oblanceolate pale green leaves, usually 1·5–4″ long by ·5–1·3″ broad, and white flowers ·5–·7″ diam., succeeded by didymous fruits, each lobe ·2–·25″ diam., again slightly 2-lobed, black when ripe. Peduncle slender, ·3–·9″, solitary.

Northern tract, Northern Purneah common, as a shrub or a tree! Mals of Puri, as a shrub, sometimes sub-gregarious! Fls. June-Sept. Fr. Oct.-Jan. Evergreen, renews leaves April-May.

Attain 3 ft. girth. Hairs on twigs and peduncles somewhat scale-like. L. glabrous or somewhat stellate-hispid on the nerves, often with quite small ones (under 1″) below the ordinary leaves, sometimes obovate acuminate, serrulate, base 3-nerved, secondary nerves 3–5, tertiaries sub-parallel. Petiole hispidly hairy, ·2″. Stipules filiform, ·15–·2″. Pedicels 2–6, ·2–·4″, thickened upwards. Buds obovoid, strigosely tomentose. Sepals ·2–·3″. Petals ·1″ oblong, the blade about as long as the gland. Gonophore densely pubescent at top. Stigma peltate with several narrow lobes.

Roxburgh states that it forms good hedges.

7. **G. disperma**, *Rottl.* Syn. G. lævigata, *Vahl.*: Gara Bursu, *K.*; Marang jowar, *S.*; Patat, *Th.*

A small tree with shortly pubescent slender branchlets, narrow leaves, green and somewhat glaucous beneath, usually 3–6″ by 1·25–2″, and white flowers 1–1·5″ diam., succeeded by didymous or 4-lobed green fruits, drupels ·25–·27″ diam.

Widely distributed. Champaran! Chota Nagpur and Santal Parganas, common along streams and nalahs! Sambalpur, in similar places! Angul! Puri, common! Mayurbhanj, common to 3000 ft.!

Fls. June-Oct. Fr. Dec.-Feb. Evergreen.

Bark grey, smooth, with slight horizontal stipular ridges. Blaze soft, thick, white, with streaks of light brown.

L. narrow-elliptic or oblong-lanceolate, acuminate, serrulate, attaining in moist localities 9″ by 3″, slightly stellate beneath, base acute, 3-nerved. Secondary nerves 3–5, oblique, cross nervules distinct. Petioles ·25–·3″. Peduncles ·75–1″. Pedicels ·5–·75″. Buds ·5″ long or more. Sepals 3-nerved, ·5–·6″. Petals less than one fourth as long, orbicular or quadrate, glandular, with very small blade.

The wood does not appear to be used.

8. **G. tiliæfolia**, *Vahl.* Syn. G. asiatica, var. tiliæfolia, *Brandis*; Jang Olat, *S.*; Dhaman, Ahsing, Gonyer, *K.*; Dhaman, *H.*, *Kharw.*; Dhaman, Dhamuro, Bhangia, *Or.*; Kultho (*Mayurbhanj*); Aintu Baranda, *Gond.*

A tree, usually small, with very broadly ovate to obovate, *unequal sided*, obtuse or shortly cuspidate, usually crenate glabrescent leaves

with the base usually auricled on one side, *slender* petioles up to 1″ long, usually thickened at the top, mostly *falcate* stipules, and peduncles usually much shorter than the petioles. Gonophore long, short or 0. Fruit didymous (one lobe sometimes failing).

General throughout the province in forest areas, attaining its best development in valleys and lower slopes of the southern hills. Fls. April–June. Fr. Sept.–Oct. Deciduous April–May.

Bark nearly smooth, sometimes with faint rings. Blaze fibrous, pink or red, with fine alternating zones of crimson and white. Attains 4¾ ft. girth in the Angul forests, usually smaller. It is rather variable.

α. tiliæfolia proper. Leaves large, 6″ or more long and nearly glabrous at the time of flowering, mostly auricled on one side, crenate, 5–7-nerved and very distinct sub-parallel cross nervules. Petiole ·5–1″, very young only tomentose. Stipules semi-cordate at base. Peduncles ·25–·3″, usually crowded and much shorter than the petioles. Buds shortly ellipsoid to oblong, somewhat tomentose, ribbed. Sepals under ·25″.

This is the common form. Champaran to Orissa!

β. L. only half-developed at the time of flowering, nearly glabrous, oblong to ovate, with sometimes sub-regular base, but very falcate or semi-cordate stipules. Fls. larger. Sepals over ·25″. Buds oblong, tomentose. Peduncles shorter, or in some plants as long as their ·5–·7″ petioles.

Singbhum! Palamau! Ascends to Neterhat, 3000 ft.

May be a hybrid with *G. vestita*.

γ. L. only half-developed, not over 3·5″ at time of flowering. Stipules only falcate while young. Buds globose and tomentose or sometimes ellipsoid just before expanding. Sepals over ·25″.

Palamau.

δ. L. very membranous, oblong to ovate with sub-regular or oblique base, half developed only at the time of flowering. Stipules linear or falcate. Peduncles few or many, slender and often as long as petiole, ·2–·5″. Buds oblong. Linear bracteoles sub-persistent (they are caducous in other forms) or caducous.

Santal Parganas! Kalahandi!

G. tiliæfolia is the "Dhaman" *par excellence*, though other species sometimes are called this. It is the best wood for *banghies* and other purposes where strength and elasticity are required.

9. **G. rotundifolia**, *Juss.* Syn. G. orbiculata, *F.B.I.*; Mirga Chara (Deer's Food), *Or.*; Kala Dhaman, *H.*

A small, usually crooked tree, with broadly ovate, broadly elliptic or orbicular denticulate or occasionally coarsely toothed leaves, easily recognised by the persistent tomentum or pubescence beneath, which gives the tree a grey-green colour. Flowers very numerous, tomentose, umbelled on slender peduncles which considerably exceed the young ·2–·3″ petioles.

Local in open jungles. Frequent on the sandstones and conglomerates of the Durgapur forest, Angul! Fls. April–May with the new l. Old l. fall in March.

Bark of old trees cracked, dark grey. Blaze deep crimson with some lighter streaks. L. young, often subequal at base, old usually oblique. Principal nerves 5–7, secondary few, tertiaries numerous, close, strong scalariform. Petioles ·3″, often thickened upwards. Peduncles fascicled, usually twice as long. Fl. buds large, woolly, globose, or broadly ellipsoid. Fls. deep yellow, ·5″ diam. Sepals ·25″, linear. Petals ·16″. Gonophore very short. Drupe grey-tomentose, slightly 2-lobed.

10. **G. elastica,** *Royle.* Inc. G. cinnamomea, *Gamble*; Syn. G. vestita, *Wall.*; G. asiatica, *Brandis* (in part); G. celtidifolia (List of trees of S.C., C.P., *Drummond* in *Journal of Botany,* 1911*); Boror, Gonyer, *K.*; Nanha Olat', *S.*; Pharsa, *Th.*; Mirgi Chara, *Or.*

A tree with very tomentose shoots, usually oblong but also ovate or elliptic, acuminate, serrate or serrulate, 5–7-nerved leaves, *tomentose* when young and often persistently white or tomentose beneath when old, with oblique but not cordate base. Petioles short (usually under ·5″ even in large leaves), stout, uniform or gradually thickened upwards. Stipules linear to setaceous, more rarely tapering. Peduncles few to many, usually stout, tomentose and divaricate, but sometimes slender in var. δ. Bracteoles narrowly linear or setaceous, more persistent than in last. Buds subglobose to oblong. Gonophore present or absent. Fruit globose, not didymous, under ·25″ diam.

Throughout the province, more abundant at high elevations! Fls. April–May. Fr. Oct.–Jan. Deciduous, the new leaves appearing on the same shoots with the fls. Attains 5 ft. girth, but is commonly only seen up to 3 ft. girth. Bark nearly smooth, grey, thick, very white in young trees. Blaze in red-brown laminations with white streaks. The layers are very close, but distinct and uniform, and the ends of the fibres and the pores in the bast in alternate layers very distinct with a lens. In young trees the blaze is soft and white. Twigs with usually red or reddish-brown bark.

Sub.-sp. 1. **elastica** proper. Royle's typical form with lobed ovate leaves, very tomentose, on some shoots attaining 11″, is found chiefly in the North-West Himalayas.

Forma α (*G. elatostemoides Bot. & Hemsley?*). Bammasuri, *Th.* Branches often drooping. Shoots when young with shaggy white or (forma *cinnamomea*) rufous tomentum. L. 3–5″, obliquely broadly ovate, acuminate or acute, persistently white beneath when old, serrulate. Stipules broadly linear or subulate. Petioles ·3″. Peduncles ·3–·75″. Bracts linear or subulate. Buds large, globose to cylindrical, very tomentose. Sepals tomentose without, about ·3–·6″. Petals oblong, ·12–·15″. Ovary villous. Stigma capitate with much lobed or fimbriate margin, or deeply 2-fid with lamellate branches. Fr. ·25″.

Ramnagar Hills, common! Chota Nagpur, especially on Parasnath and the higher hills! Also in the lower hills! Mayurbhanj! Angul (rare)!

Forma β. Less tomentose. L. becoming quite green beneath, but permanently stellately puberulous, attaining 6·5 by 3·5″. Singbhum!

Sub.-sp. 2. **vestita,** *Wall* (sp.).

Forma γ. Wallich's type. Densely brown, villous on twigs and peduncles. Peduncles very short and pedicels equalling or exceeding them. Leaves oblong-acuminate, stellately villous beneath. Sepals ·22–·29″. Petals linear-oblanceolate, 1″. Found in Sikkim and Nepal, Himalayas, but scarcely enters our province, except perhaps on the Purneah border.

Forma δ. Less densely tomentose or villous than *elastica*. L. oblong or narrowly ovate, 3–6″, scarcely or very finely tomentose, ultimately green or hoary beneath, finely acuminate. Stipules as long as petiole, linear to setaceous, but sometimes with sub-auricled base. Peduncle slender, ·3–·75″. Pedicels shorter than peduncles.

---

* I have now examined the Malayan material of *Grewia* in the Calcutta Herbarium and compared Jussieu's description of *G. celtidifolia* in *Ann. Mus. Nat.*, 1804, and do not think there is sufficient evidence of *Grewia elastica* being the same species.

Buds oblong or clavate before opening. Bracts setaceous. Sepals ·3–·4″. Petals linear or linear-oblong, ·12–·2″.
Gaya Ghats! Singbhum, frequent! Baud (called Baranga)!
The wood is much valued, but is not as good as that of *G. tiliæfolia*.

11. **G. Hainesiana,** *Hole. Ind. For.*, xliii., 316. Syn. G. asiatica, *Roxb. non Linn.*; Phalsa, *H.*; Pat-dhaman, *Kharw.*; Olat, *S.*

A tree, usually small, but (in our area) not at all shrubby, with tomentose shoots, very broadly ovate or sub-orbicular, obtuse or shortly cuspidate leaves, 4–7″ by 3–6″, with regular or usually oblique, very rarely cordate, 5–7-nerved base, sharply (often doubly) serrate leaves, tomentose when young, but green both sides when mature. Petioles stout, uniform or clavate, ·3–·75″. Peduncles several up to ·8″, usually exceeding the petiole. Flowers large. Gonophore long. Fruit purple, globose, ·3–·5″ diam., pyrenes 1–2, 1–2-celled.

Often cultivated in our area for its fruit. Ranchi! Palamau! Manbhum! Purneah! Muzafferpur!
Fls. April–May. Fr. June–July.
Bark smooth, thick. Blaze thin brown, often with chlorophyll, thin, pale yellow, or in older trees light pink streaked white, the harder and softer bast tissues distinctly zoned. L. sometimes slightly lobed, often somewhat pubescent beneath when mature, but green. Buds up to ·25″, ribbed. Sepals ·3–·4″ long. Petals oblong, half as long, emarginate or 2-fid. Stigma 4-lobed.
The Fr. is eaten and a sherbert is prepared from it. Kanjilal states that the sweet-makers of Saharanpur use the mucilaginous bark to clarify sugar.

12. **G. asiatica,** *L.* (not of *Roxb.*). Phalsa, *H.*

A shrub with tomentose shoots, sub-orbicular, cuspidate, sharply and often coarsely doubly serrate leaves, 3–4″ long, permanently white beneath with regular or oblique or cordate 5–7-nerved base. Petioles ·25–·5″, often slender and clavate. Peduncles usually many, long and slender, far exceeding the petioles and often 3–4 times as long, sometimes over 1″. Flowers large. Gonophore long. Fruit red (to purple ?), globose, ·25–·3″ diam., pyrenes 1–2, always 1-celled only.

Cultivated only, and very rare in our area in the gardens of Indians. Rairakhol!
Stipules linear, subulate or lanceolate, variable as in the last. Fl. buds broadly cylindric or clavate. Sepals ·45″ long, stellately pubescent or tomentose (as in last). Petals oblong, ·25″, jagged or entire, not bifid, gland with a wide fleshy margin, pubescent towards the edges. Stigma with 4 short, rounded lobes, style much thickened above.
The acid fruit is eaten.

13. **G. sapida,** *Roxb.* Syn. G. Campbellii, *Watt* (in descriptive catalogue); Barsa pakor, *S.*

An undershrub with more or less perennial shoots (if not burnt), from a woody rootstock, with broadly oblong to sub-orbicular and obovate rounded or obtuse serrate leaves, usually with cuneate 5-nerved base, very short petioles ·1–·25″, lanceolate or subulate stipules, and very long slender peduncles ·5–1·25″. Fls. large, drupe globose, sometimes somewhat lobed, with 1–3 1-seeded pyrenes.

On the hills and plateaux, especially on fire lines and other grassy places annually burnt, in all districts of Chota Nagpur! Northern area, in grass lands towards the northern boundary, Champaran! Purneah! Fls., Fr. April–June.
L. attain 4″, usually harsh and hispidly stellate both sides or glabrous (var. *Campbellii*) and usually green, sometimes pale beneath, often irregular and

somewhat lobed but with a rounded or truncate, very rarely acute apex. Peduncles hispid, 3-flowered. Pedicels ·25–·5″. Buds large, clavate, ·25″ or more before opening. Sepals ·3″. Petals ·17″, usually 2-fid. Drupes ·25″, stellately hairy.

The Fr. is eaten.

14. **G. Rothii,** *DC.* Syn. G. excelsa, *F.B.I.* non *Vahl*; G. salvifolia, *Roxb.* non *Heyne*; Bursu, *K.*; Phulari, Miri Chara, *Or.*; Bansuli, *Gondi.*

A pretty shrub, rarely a small tree, with hoary branchlets, oblong- or ovate-lanceolate or lanceolate, acuminate, serrulate or crenulate, 3(-5)-nerved leaves always beautifully white beneath and short petioles rarely over ·25″. Stipules broadly linear to linear-subulate, equalling or exceeding the petiole. Peduncles 1–6, very slender, ·5–1″ long, with 3 very slender pedicels, clavate beneath the flower and linear bracts ·17″ long. Fruit about ·25″, sub-persistently hoary, rarely lobed, finally purple.

Not noted from the Northern area. Common in the forests throughout the Central area, especially in the hills! Also found in all districts of the Southern area! Fls. April–Sept. Fr. June–Oct. Evergreen.

Twigs often purple. L. usually 2–3″, but attaining 4–5″ by 1·5″, acuminate, rarely only acute. Sepals ·3″, linear or linear oblong. Petals about ·12″, entire oblong.

Bursu is one of the woods used by the Kols in producing fire (from its dry sticks). The flowers are often borne in great profusion and it is well worth a place in the garden. The bark gives a fibre used for tying.

5. ELÆOCARPUS, *L.*

Trees with simple leaves and flowers in axillary racemes. Petals usually laciniate. Stamens usually indefinite, inserted on the inside of the swollen annular torus, usually in groups opposite to the petals and alternating with the glands of the torus; anthers linear, opening by a pore. Ovary 2–5-celled, cells 2–many-ovuled. Fruit drupaceous, which is 5–3 or 1-celled, with 1 pendulous seed in each cell, albumen fleshy, cotyledons flat.

A. L. 3–5″.
- Petiole ·5–·75″. Fr. globose, 4–5-celled . . . . 1. *ganitrus.*
- Petiole ·75–1·8″. Fr. ellipsoid, 3-celled . . . . 2. *serratus.*

B. L. 5–8″.
- Petiole 1–2·5″, blade 7–12″, glabrous, exc. nerves . . . . 3. *robustus.*
- Petiole ·7–2″, blade 5–8″, pubescent . . . . 4. *Wallichii.*

1. **E. ganitrus,** *Roxb.* Rudrak, *H.*

A moderate-sized tree, with elliptic-lanceolate or oblong, very shallowly serrate, nearly glabrous leaves, 3–6″ long, secondary nerves 10–15. Petiole ·5–·75″, not at all geniculate, pubescent. Flowers white, ·5″ diam, in rather dense racemes 2–3″ long, mostly from old leaf axils, buds narrow, shortly beaked, sparsely silky, sepals ·22–·3″ long, petals ·3–·4″, fimbriate. Ovary 5–4-celled. Fruit globose, ·75–1″ diam., finally a fine deep blue or blue purple. Stone globose, with 4–5 vertical grooves and beautifully tubercled, 4–5-celled and -seeded.

Sometimes planted and possibly originally native in Purneah, as it occurs in Sikkim and Nepal! Fls. Aug.–Feb. Evergreen.

The stones are often seen strung into rosaries.

2. **E. serratus,** *L.* Var. floribundus. Syn. E. floribundus, *Blume*; Jalpai, *Nep.*

A moderate-sized tree with elliptic or elliptic-obovate, crenate-serrate, glabrous or nearly glabrous leaves, 3–5″ long, with a petiole ·75–1·8″ long, slender, and with a thickening each end. Flowers white, in rather dense racemes, 2–4·5″ long, mostly from old leaf axils, rhachis hairy, buds ellipsoid, silky, sepals ·2″–·25″, petals laciniate half-way down, fimbriate. Stamens 20–30, bearded or not at apex. Ovary 3-celled. Fruit ellipsoid, green, smooth, stone 3-grooved, nearly smooth.

Planted in Purneah as well as native! *Buchanan Hamilton* recorded it as common there. Ranchi, *Wood* (no doubt planted).

Fls. June–July. Fr. Dec.–Jan. Evergreen.

Bark quite smooth, blaze blood red, then lighter red. The leaves (like many other species of this genus) turn red before falling.

3. **E. robustus,** *Roxb.* Syn. E. lucidus, *Roxb.*?; Nard Champa, Panasia, Patragundi, *Or.*

A moderate-sized or large tree, 6 ft. girth, with smooth pale bark, large oblong acuminate, shallowly crenate or crenate-serrate leaves, 7–12″, and numerous lax lateral racemes, mostly from below the leaves, some axillary. Flowers white, ·4–·5″ diam. Drupe ellipsoid, 1″–1·5″, yellow, 3-celled.

Along streams in evergreen forest. Mals of Puri, common! Bonai, *Cooper*! Mayurbhanj, Meghasani, 3000 ft.

Fls. May–June. Fr. Sept.–Oct. Evergreen. Old leaves turn red before falling.

Blaze hard brown, then yellowish. Shoots tomentose. L. attain 4·5″ in breadth, smaller ones sometimes ovate or lanceolate, base mostly obtuse or rounded with usually 1 or 2 secondary nerves close to base and 1–2 glands, glabrous except the nerves of young leaves. Secondary nerves 9–13 strong. Petiole 1–2·5″, usually thickened both ends and sometimes with minute subulate glands at apex. Racemes 3–5″, pubescent. Bracts small, linear, 2–5-gland-toothed, very caducous. Pedicels ·2–·3″. Buds ovoid, 5-ribbed. Sepals lanceolate oblong, acute, ·17″, thinly tomentose. Petals ·2″, cuneate fimbriate, pubescent on margin. Stamens about 40–50. Anthers minutely 2-valved at the tip, minutely pubescent and usually bearded with 4–5 small bristles on one of the valves. Disc of 5 large tomentose lobes. Ovary tomentose. Drupe 1 (–3?)-seeded. Endocarp very hard, deeply rugose.

A common tree in the Duars and Chittagong. I doubt whether *E. lucidus, Roxb.*, is distinct; both the characters on which the species is separated occur on some flowers and leaves and not on others of the *same* tree!

4. **E. Wallichii,** *Kurz.*

A large tree with tawny tomentosely-villose shoots, thick twigs and oblong or somewhat elliptical or obovate-oblong, rather distantly serrate leaves, 5–8″ long, with the petiole ·7–1·7″ long, and slightly thickened both ends. Flowers and racemes very similar to those of *E. robustus*, but more tomentose.

Mayurbhanj, Meghasani, 3000 ft.! Fls. April.

Distrib.: Burmah.

Bark nearly smooth. Blaze hard reddish brown, then yellowish. L. somewhat chartaceous, shortly acuminate, base rounded, serratures with deciduous points, beneath puberulous and densely pubescent on the nerves and young l., also tawny hairy on the nerves above; secondary nerves strong oblique, 10–12 each side. Stipules minute, caducous. Top of petiole with 2 or sometimes with 2 or more pairs of stipellæ-like glands. Racemes 4–7″ at the scars of fallen leaves. Sepals

oblong-lanceolate, tomentose, ·15″. Petals as long laciniate. Anthers minutely puberulous, mostly bearded with few short hairs. Fr. not seen.
Kurz says that the wood is red.

FAM. 29. EUPHORBIACEÆ.

Plants of very various habit, trees, shrubs or herbs, sometimes with thick fleshy branches, very rarely climbers, sap often milky, stellate hairs frequent, cystoliths rare, stinging hairs very rare. Leaves simple, alternate (see note), usually stipulate. Inflorescence very various. Flowers unisexual, monœcious or diœcious, regular, but sometimes reduced to single stamens or ovaries in composite, sometimes irregular, inflorescences resembling single flowers. Perianth often small or 0, usually calyciform, in some cases however, well developed and with differentiated calyx and corolla. Calyx inferior, valvate or imbricate, or open in bud or sepals in two series. Petals free, sometimes squamiform, when larger, imbricate or sub-valvate. Perianth or petals sometimes different in the two sexes, or petals present in one sex and not in the other. Disc hypogynous, often annular, lobed, or of glands intrastaminal or alternating between the outer series of stamens in the male. Male flower with stamens isomerous with the sepals or petals or fewer or numerous, central in the flower or with a pistillode, anthers 2-locular, rarely 4-locular, variously affixed, longitudinally, obliquely or transversely dehiscent, or with an apical pore. Female flower with or usually without staminodes. Ovary mostly 3-celled, rarely 2-4-celled, very rarely 1- or 5-many-celled, style 0 or 1 with as many branches as the cells, and branches sometimes deeply 2-more-fid, sometimes branched from the base, stigmas various. Ovules in each loculus, 1 or 2 collateral, anatropous pendulous from the inner angle, with ventral raphe and micropyle upwards and outwards, funicle or placenta very often dilated and pulvinate above the micropyle into an *obdurator* which sometimes covers a considerable part of the ovule. Fruit normally a 3-celled capsule becoming 3-coccous and falling away from a persistent columella (as in some Geraniales), sometimes, however, loculicidal or baccate or drupaceous, with as many cells or pyrenes or cocci as there are cells in the ovary or fewer. Seeds sometimes as many, sometimes fewer than the ovules, not rarely strophiolate (with a caruncle), albumen usually fleshy, copious, rarely thin or 0. Embryo central, straight or nearly so, with large, broad, flat foliaceous, often palmi-nerved cotyledons, very rarely fleshy or folded cotyledons, radicle superior, shortly exserted from, rarely included between, the bases of the cotyledons or elongate.

NOTE.—Compound or opposite l. are very rare, but, as in the Sterculiaceæ, palmately-nerved and palmate l. are common, and digitate l. therefore, as might be expected, sometimes occur (*e.g. Bischofia, Manihot*); true pinnate l. are never found, but the *pseudo-pinnate leaves* of many Phyllantheæ are very interesting, and may indicate a method by which one class of pinnate l. have been evolved. These are small, simple distichous leaves on branchlets of finite growth and which are deciduous as a whole; they strongly resemble the pinnate leaves of some of the Oxalidaceæ and are often stipulate, but some of them bear fls. In some of the cactus-like *Euphorbias* the l. are sometimes small and caducous; these may easily be distinguished from Cactaceæ by their milky juice, and the spines, if present,

being paired (stipular). Opposite L. are found in *Euphorbia*, *Gelonium*, and *Trewia*, but it is interesting to note that the seedlings of *Trewia* have alternate leaves!

The germination is epigeal in all cases examined by me, even where, as in *Jatropha*, the cotyledons are very thick and fleshy. The expanded cotyledons are usually broad and palmately-nerved, sometimes, as in *Bridelia*, retuse, and much resemble those of the Malvales.

KEY TO EUPHORBIACEÆ.

† Fls. distinct, *i.e.*, not reduced to single stamens or a single ovary contained in an involucre. (Nos. 1–39.)

I. Cells of ovary 1-ovuled. Juice sometimes milky (2, 3, 19, 20). (Nos. 1–21.)
  A. Petals present in one or both sexes, or if absent, calyx petaloid.
    1. Petals in both sexes, often showy. Stamens usually 10, central.
      Fls. white, solitary and racemose . . . . . 1. *Dimorphocalyx.*
      Fls. in 2–3-chotomous cymes, green or red . . . 2. *Jatropha.*
    2. Calyx petaloid, petals 0. Fls. large.
      L. palmi-lobed, juice usually milky . . . . 3. *Manihot.*
    3. Petals smaller than calyx, often 0 in female. Fls. racemed.
      a. Anthers erect in bud.
        Calyx valvate. Stellately pubescent herbs . . 4. *Chrozophora.*
        Calyx imbricate or open. Glabrous shrubs . . 6. *Codiæum* (p. 104).
      b. Anthers reversed in bud. Shrubs, often stellate . 5. *Croton.*
  B. Petals absent in both sexes. (Nos. 7–21.)
    1. Calyx valvate in bud. (Nos. 7–15.)
      a. Stamens many, or if few (some *Macaranga*) then L. peltate.
        i. Stamens not branched. Trees with usually palmi-nerved leaves.
          * Anther-cells oblong, 2-celled, cells oblong.
            L. opposite. Styles long, linear. Fr. drupaceous 7. *Trewia.*
            L. alternate. Styles fimbriate. Fr. 2–3-coccous 8. *Mallotus.*
          ** Anthers mostly 4-celled, cells subglobose.
            L. peltate. Styles simple. Fr. 1–3-coccous . 9. *Macaranga.*
            L. not peltate, penninerved. Styles 2-fid . 10. *Cleidion.*
        ii. Stamens central, connate, repeatedly branched.
          * L. penninerved. Fls. spicate or female solitary.
            L. sub-verticillate. Ovary scaly or tubercled . 11. *Lasiococca.*
            L. alternate, narrow. Ovary pubescent . . 12. *Homonoia.*
          ** L. broad, palmi-lobed and -nerved. Fls. racemed 13. *Ricinus.*
      b. Stamens few (under 10). L. not peltate. Fls. in androgynous racemes. Anther-cells free above.
        Female fls. without large bracts, styles linear, simple . . . . 14. *Claoxylon.*
        Female fls. in large bracts. Styles laciniate . . 15. *Acalypha.*
    2. Calyx imbricate.
      a. Stamens 10 or more.
        Small trees, L. punctulate. Fl.-clusters axillary . 16. *Gelonium.*
        Shrubs, L.-base 2-glandular. Fl.-clusters racemed. 17. *Baliospermum.*
      b. Stamens under 10.
        Climbing herbs or undershrubs with pungent hairs 18. *Tragia.*
    3. Male calyx open in bud. Stamens under 10. Fls. spiked or racemed.
      a. Trees or shrubs with copious milky juice.
        Calyx subentire or slightly toothed . . . . 19. *Sapium.*
        Calyx 3–5-sepalous . . . . 20. *Excœcaria.*
      b. Herbs. L. linear. Fr. muricate . . . . 21. *Sebastiania.*

II. Cells of ovary 2-ovuled. Juice very rarely milky. (Nos. 22–39.)
  A. Petals present, small. Calyx valvate. Filaments on a column.
    Ovary 2-celled. Fr. baccate with 2 pyrenes . . 22. *Bridelia.*
    Ovary 3-celled. Fr. capsular . . . . . 23. *Cleistanthus.*

B. Fls. apetalous. Calyx imbricate in bud. (Nos. 24–39.)
1. Fls. axillary, solitary, or mostly clustered. L. simple, entire, usually on short branchlets like the leaflets of a pinnate L. (Phyllantheæ proper.)
a. Stamens 3–5. Styles distinct, usually 2-fid. Ovary cells 3, rarely 4. Ovules collateral. Fls. with open mouth.
i. Diœcious. Stamens 5, opposite the sepals, pistillode central.
Fr. baccate white, or small and of 3 2-valved cocci 24. *Flueggea.*
ii. Stamens 3–5, central. Fr. of 3 crustaceous, 2-valved cocci.
* Fls. monœcious. Herbs or undershrubs.
Sepals 6. Stamens 3, connate. Styles very short. Fr. ovoid . . . . 25. *Agyneia.*
Sepals 5–6. Stamens 3. Capsule depressed, globose . . . . 26. *Phyllanthus.*
** Trees. Fls. diœcious. Sepals 4. Stamens 4 . 27. *Prosorus.*
iii. Stamens 3–4, central, connate. Fr. a drupe, with 3–4-celled angled putamen. Trees.
Leaflets narrow. Sepals 5–6. Stamens 3. Styles twice 2-fid . . . . 28. *Emblica.*
Leaflets large. Sepals 4. Stamens 4. Styles 4 29. *Cicca.*
b. Stamens 3–12, central. Styles 0, or combined into a column with minutely toothed tip. Ovary cells 5–15. Fls. with open mouth.
Stamens 4–7, free or connate. Ovary 5–12-celled. Ovules superposed. Fr. baccate . . . 30. *Kirganelia.*
Stamens 3–12, connate. Ovary 3–15-celled. Ovules collateral. Fr. of 2-valved cocci sometimes with separable epicarp . . . . 31. *Glochidion.*
c. Stamens 3 in a central column. Male fls. turbinate or disciform, fleshy, with the mouth nearly closed. Styles flat, spreading, 2-lobed, or stigmas minute, sessile.
Column terete, anthers contiguous . . . . 32. *Breynia.*
Column 3-gonous, anthers discrete on the angles . 33. *Sauropus.*
d. Stamens few or many, with large erect anthers. Styles with dilated stigmas. Fr. indehiscent.
Stamens 2–4, central. Fr. a 1-celled drupe . . 34. *Putranjiva.*
Stamens inserted round a vacant central area or pistillode. Fr. 2-celled, coriaceous . . . 35. *Cyclostemon.*
2. Fls. in spikes or racemes, diœcious. L. simple. Stigmas short, broad, or subulate. Fr. not or tardily dehiscent.
Fls. minute, bracts large. Stamens central. Fr. dry or fleshy . . . . 36. *Aporosa.*
Fls. minute, bracts small. Stamens round a pistillode. Fr. a compressed small drupe . . 37. *Antidesma.*
Fls. large. Stamens round a pistillode. Fr. dry, large . . . . 38. *Baccaurea.*
3. Fls. panicled. L. 3-foliolate. Fr. baccate . . . 39. *Bischofia.*

†† Fls. reduced to single-pedicelled stamens, enclosed in an involucre of more or less connate, sometimes coloured bracts, with or without a single female fl. without perianth, the whole resembling a single fl. Juice always milky. L. simple, alternate or opposite (Nos. 40–end.)
A. Involucres regular or subregular (with gland unilateral).
Glands on the involucre 1–5, discrete, inner bracts not connate . . . . 40. *Euphorbia.*
Glands on the involucre connate into a continuous ring. Inner bracts round group of male fls. more or less connate and forming a tube round the female . . . . 41. *Synadenium.*
B. Involucre very obliquely zygomorphous, often coloured 42. *Pedilanthus.*

1. DIMORPHOCALYX, *Thw.*

Glabrous trees with buds sometimes scaly, alternate, entire penninerved leaves and moderate-sized flowers in axillary, or terminal, few-flowered racemes or clusters or solitary, monœcious,* male and female different-looking. Male calyx cupular, or 5-partite or toothed, corolla well developed, campanulate (in our species), petals contorted in bud. Stamens 10–20, sometimes 2–3-seriate, the inner series with connate filaments, or all on a short columnar receptacle; anther-cells adnate to the thick connective, pistillode 0. Female flower rotate, sepals 5, enlarging in fruit, ovary 3-celled, styles erect 2-fid, ovules 1 in each cell. Capsule of 3 2-valved crustaceous cocci.

1. **D. glabellus,** *Thwaites.* (Perhaps not distinct from D. Lawianus, *Hook f.*)

A small tree with dark green elliptic, ovate or (some) obovate shortly acuminate leaves, 2·5–5·5″, pale beneath, and with about 8 slender, scarcely raised secondary nerves, little stronger than the intermediate and reticulations. Male flower solitary or clustered, on short, lateral scaly shoots from the old wood; female much larger, solitary on the new shoots. Males white, ·35–·4″ long, with a spreading corolla, ·5″ diam., petals ·5″ long, oblong, nearly free, obtuse. Stamens 10–12, outer series free, or connate to column, with longer free filaments than the inner series on top of column. Female ·7–·8″ diam., with 5 spreading, obovate, rounded or retuse sepals. Petals free, ·4–·5″ by ·2″, broadly oblong. Disc annular. Capsule ·5″ diam., globose, 3-lobed and 6-grooved, thinly strigose-hairy, seated on the large spreading calyx.

Ravines in Angul! Fls., Fr. March–April. Evergreen.

Bark smooth or on some branches with large ridges of cork, twigs white or reddish, short, new shoots with several brown, shining, ovate scales, quite glabrous. Petiole ·25–·4″, stipules small, triangular or ovate. Male fls. with very short pedicels, calyx cupular or urceolate only ·1″ long, 5-toothed, nearly glabrous. Female fls. with peduncle, ·8–1·5″, solitary, terminal, sometimes bracteate. Petals overlapping to right in bud. Ovary pubescent. Fruiting sepals very unequal, ·25–·5″ long, strongly nerved.

A very interesting genus, the staminal column sometimes with two whorls of stamens and terminating in 1–2 stamens; petals contorted in bud and well developed remind one much of the Malvales.

2. JATROPHA, *L.*

Herbs, shrubs or trees, often glandular, with alternate palmately-nerved, entire or palmately-lobed or -partite leaves. Stipules often ciliate. Flowers green or coloured in terminal cymes, monœcious, the central one in the cyme or its forks usually female. Sepals 5, imbricate. Petals 5, contorted, free or connate. Disc entire or of 5 glands. Stamens usually 10, filaments, or the interior ones only, connate, anthers erect with vertical dehiscence. Pistillode in male 0.

* Perhaps diœcious in some species but wrongly termed so in *D. glabellus*, the male and female inflorescences being on separate branches but the same tree.

Ovary 2-4-celled, styles connate below, 2-fid, sometimes again 2-lobed. Ovules 1 in each cell. Fruit of 2-4 2-valved cocci, endocarp crustaceous or bony. Seeds ovoid or oblong.

A. Fls. greenish-yellow, petals more or less cohering . . . 1. *curcas.*
B. Fls. red, petals free or nearly so.
 1. L. palmately-lobed or partite, with 3-several basal nerves.
  L. multi-fid, stipules eglandular . . . . 2. *multifida.*
  L. lobed, gland-serrate, stipules glandular . . . . 3. *gossypifolia.*
  L. lobed, eglandular. Stems with swollen base . . . 4. *podagrica.*
 2. L. panduriform, sub-penninerved . . . . . . 5. *panduræfolia.*

1. **J. curcas,** *L.* Kulajara, *K.*; Totkabindi, *M.*; Bhernda, *S.*; Baghrandi, *H.*; Baghbarinda, *Beng.*; The Physic-nut.

A shrub or small tree, 10–20 ft., with glabrous (exc. when very young), 3-5-angled or -lobed leaves, 4-6″ diam., and small yellowish flowers with a campanulate 5-lobed corolla, in terminal cymose panicles. Capsule subglobose or ellipsoid, 1″ long.

Very common in village hedges throughout the area. Native of America. Fls. May-Oct. Deciduous in the c.s., when it is frequently conspicuous from the persistent capsules.

Branches thick with large leaf scars. L. broad, cordate, usually 5-angled. Petioles 4-6″. Stipules 0 or very early caducous (?). Male fls. on short articulate pedicels, corolla somewhat hairy, stamens 10 with 5 inner connate. Female Fls. usually in the forks of the cymes, pedicelled. Stigmas 2-fid.

Easily grown from seed or cuttings. The seeds yield by expression about 30 per cent. of a pale yellow oil, which in doses of 12-15 drops acts as a purgative equal in action to one ounce of castor oil and is poisonous in larger quantities. The ill effects are partially corrected by lime-juice. Externally it is used for skin diseases (*Indian Plants and Drugs*).

2. **J. multifida,** *L.* Coral Plant; Purging-nut.

A handsome garden shrub, easily recognised by its orbicular, long-petioled leaves, 3–5″ diam., palmately cut into narrow caudate segments, capillary multifid stipules, and flat-topped cymes of coral-red flowers. Disc of female urceolate. Capsules sub-fleshy, large yellow, 3-lobed.

Common in Indian gardens. Fls., Fr. chiefly r.s.

3. **J. gossypifolia,** *L.* Bhernda, verenda, *K.*, *S.*, *H.*; Lal-bherenda, *Beng.*

A shrub, 3-6 ft., with palmately 3-5-lobed leaves, easily recognised by the stipitate, yellow viscid glands, which cover the leaf margins, petioles and stipules, and by the small red flowers in glandular corymbose cymes. Stamens 10–12.

Very common in waste ground and by road-sides. A native of Brazil, now naturalised. Deciduous in c.s. Fls., Fr. r.s.

4. **J. podagrica,** *Hook. Bot. Mag. t.* 4376. Gouty-stemmed Jatropha.

A shrub with smooth stems suddenly swollen at the base, long stalked, glabrous, cordate, 5-lobed leaves with lobes rounded, glandular fimbriate stipules, and cymes of scarlet flowers.

Common in gardens. Fls. chiefly r.s. Native of Panama.

5. **J. panduræfolia,** *Andr. Bot. Rep. t.* 267. Syn. J. hastata, *Jacq. Enum. Pl. Carib.**

A pretty, rather slenderly branched shrub, with fiddle-shaped l. which are penninerved except for the two slender lateral nerves at the base. Fls. in long-peduncled corymbose cymes, few female and many male, 1" diam., vivid crimson. Calyx small, 5-lobed. Petals large, obovate. Stamens central in a double whorl of 5 short and 5 larger stamens, the inner whorl with more or less connate filaments.

Frequent in gardens. Native of Cuba. Fls. most of the year.

Other species occur in gardens.

3. MANIHOT, *Adans.*

Shrubs or weak trees, often with tuberous roots and milky juice, alternate, petioled, palmately nerved, simple or lobed or palmipartite leaves. Flowers large, monœcious, in simple rarely compound racemes, males usually above and females below. Calyx often petaloid, campanulate or urceolate, 5-lobed or 5-fid, petals 0, stamens 10 in two whorls; filaments free, inserted between the lobes or glands of the disc; pistillode 0 or 3-lobed, disc in female hypogynous, ovary 3-celled, styles shortly connate at the base, spreading, dilated or lobed at the tips, cells 1-ovuled. Capsule of three 2-valved cocci.

L. peltate, mostly 3-partite. Small tree . . . . 1. *Glaziovii.*
L. not peltate, mostly 7-partite. Shrub . . . . 2. *utilissima.*

1. **M. Glaziovii,** *Müll.-Arg.* Ceara or Manicoba Rubber.

A small tree, about 30 ft. high, with a rounded head of greyish-green, long petioled, peltately attached leaves, varying from simple lanceolate to 3–7-palmipartite on the same tree, 6–10" broad. Flowers in branched racemes, solitary in the axils of small bracts. Capsules subglobose.

Occasionally planted. The tree is said to flourish in dry rocky soils at elevations of about 4000 ft. and might succeed at Neterhat. It grows from cuttings or from seed, which have a hard testa and take a year to germinate.

Para rubber is derived from *Hevea brasiliensis*, another Euphorbiaceous tree.

2. **M. utilissima,** *Pohl.* Roti alu, *Vern.*; Cassava; Tapioca Plant.

A sub-herbaceous shrub, with large tuberous roots, somewhat like those of a dahlia, very nodose stems, about 5 to 9 ft. high, and *Simal*-like leaves with 3–7 narrow segments. Flower not seen in our area.

Occasionally cultivated. The tubers sometimes attain very large size and have milky juice. They are eaten like yams. Their starch constitutes *Tapioca*, which is a granulated form imported chiefly from Brazil.

4. CHROZOPHORA.

Coarse herbs, less often undershrubs, clothed with stellate tomentum, very rarely nearly glabrous. Leaves usually undulately toothed, plicate, rugose or bullate or nearly flat, often with two glands at apex of petiole beneath. Flowers monœcious dichlamydeous, in short dense racemes in the upper axils, solitary in the bracts. Males above, sub-sessile. Females below, pedicelled, fewer. Calyx of male

* *J. hastata, Jacq.*, has priority, but the description is so meagre that it is not possible to be sure of the plant intended.

closed in bud, ultimately valvately 5-lobed, narrower in female. Petals 5, usually dirty yellow, externally lepidote, narrow or occasionally obsolete in female. Stamens 5–15, filaments connate, at least below, central; anther-cells parallel. Disc of 5 short rather prominent glands alternating with petals in female. Pistillode 0. Ovary 3-celled, with peltate scales or stellate hairs. Styles 3, 2-fid, arms usually red. Ovule 1 in each cell. Capsule 3-lobed, pericarp clothed with stellate hairs, or with flat, sometimes pectinate scales, usually tinctorial. Seeds without caruncle. Albumen fleshy. Cotyledons broad, flat.

Prostrate. L. eglandular at base, stellate hairs stipitate . . . 1. *prostrata.*
Erect. L. 2-glandular at base, stellate hairs sessile . . . . 2. *Rottleri.*

1. **C. prostrata,** *Dalz.* (vide *Kew Bull*, ii, 1918). Syn. C. plicata, *β* genuina, *Muell.*

A prostrate annual with branches 4–8″ long. Leaves ·5–1″, usually ovate with rounded tip, covered with more or less stipitate stellate hairs, base eglandular; radical rosulate, sub-persistent. Petals yellowish, stigma orange. Capsule when mature grey-black, scarcely tinctorial.

Moist places. Behar, Patna, *Ham.*; Naoranga, near R. Son., *Jacq.* (*teste Prain, loc. cit.*). Fls. Jan.–May.

2. **C. Rottleri,** *A. Juss.* Syn. C. plicata, *F.B.I.*; Croton plicatum, *Roxb.*

An erect annual, or sometimes perennial. Leaves all cauline 1·25–3″, rarely 4″, sometimes broader than long, usually orbicular, with 3 rounded lobes; margin usually undulate-crenate, rarely ovate or acute or subacute, with subentire margins, hairs rough, sessile stellate. Petiole long. Racemes long for the genus, 1–2″, equalling or exceeding the uppermost leaves. Petals yellow. Stigma red. Capsule ·3″ diam., densely stellate-tomentose, red-purple when mature and very tinctorial.

Waste places, fields and roadsides. Common! Behar, *Jacquemont*, to Maldah, *Vicary* (*fide Prain, loc. cit.*). Chota Nagpur, common! Santal Parganas! Fls., Fr. most of the year. Probably occurs in all districts.

Cloth moistened with the juice of the green capsules soon becomes blue after exposure to the open air. *Roxb.* (under *Croton plicatum*).

5. CROTON, *L.*

Trees or shrubs, rarely herbs, often scaly or with stellate hairs, alternate, rarely opposite, leaves, 2-glandular at the base. Flowers usually greenish in terminal racemes, often clustered in the axils of the small bracts, monœcious, rarely diœcious. Calyx 4–6-partite, sepals imbricate or sub-valvate. Petals as many, sometimes shorter than the sepals. Disc glands as many opposite the sepals. Stamens usually many on a hairy and sometimes scaly receptacle, filaments free, inflexed in bud, anthers adnate. Pistillode 0. Female flower sepals usually broader than in male, rarely accrescent, petals smaller or 0. Disc annular or of glands. Ovary 3- (2–4-celled), styles long, 2–4-cleft, ovules 1 in each cell. Capsule 3-valved, or of 3 deciduous 2-valved cocci. Seeds smooth, caruncle small.

I. Small trees.
  L. penninerved. Ovary lepidote . . . . . . 1. *oblongifolius.*
  L. palmately nerved. Ovary stellately hispid . . . . 2. *tiglium.*
II. Large scandent shrub.
  L. palmately nerved. Ovary stellately woolly . . . . 3. *caudatus.*
III. Undershrub or sub-herbaceous.
  L. with 3 basal nerves. Ovary stellate-hairy . . . . . 4. *sparsiflorus.*

The handsome garden shrubs commonly known as "Crotons" belong to the genus *Codiæum, Rumph.*, and mostly to the species *C. variegatum, L. Codiæum* differs from *Croton* in that the stamens are erect in the bud and the style undivided, subulate. *C. variegatum* has an extraordinary variety of leaf forms. In some of these the lamina is discontinuous and in some the base of the second portion or upper portion cup-shaped. It is a native of the Pacific Islands.

1. **C. oblongifolius,** *Roxb.* Mahson, *Th.*; Kuti, Kuti-konyer, *K.*; Gote, *S.*; Bhain swan, *Kharw.*; Putol, *Mal P.*; Poter, *Ur.*; Maisonda (Koderma); Masundi, *Or.*; Putri, *Beng.*

A small tree, with rather large coriaceous, more or less serrate, or coarsely, obtusely or acutely, toothed or repand, oblong or narrowly elliptic, or elliptic leaves, 4–12″ (on same plant) long, the larger with over 12 fine spreading secondary nerves, mature glabrous. Flowers ·3″ diam., diœcious or monœcious, in long racemes, 5–12″, with lepidote or nearly glabrous rhachis, furnished with linear or minute subulate bracts. Capsule ·4–·5″ long, covered with flat scales, splitting into 2-valved cocci.

Champaran, sometimes gregarious as undergrowth in Ramnagar! Purneah! Santal Parganas, sometimes gregarious! Gaya, common on the ghats! Throughout Chota Nagpur! Bonai, *Cooper*! Mayurbhanj! Sambalpur! Fls. Jan.–Feb. Fr. April. More or less deciduous at the time of flowering and fruiting. L. turn red before falling.

Bark smooth, blaze streaked pink and white. L. with long or short petiole, acuminate or acute to rounded at apex, usually narrowed below, but rounded or subcordate at top of the petiole, young lepidote. Racemes numerous from the uppermost axils with many linear or sub-foliaceous oblanceolate bracts at their base, male pedicels ·25–·3″ long, fls. densely villous within, outside lepidote, sepals ovate or triangular, petals rather longer, thinner, oblong, obtuse, stamens about 12. Female racemes and pedicels shorter. Ovary lepidote with 3 long branched styles. Seed smooth, brown.

The plant is described by *Roxburgh* as monœcious, "a few females mixed with the males," but it is sometimes, at least, diœcious.

The bark and root are given as a purgative and also as an alterative in dysentery, *Campbell.*

2. **C. tiglium,** *L.* Jamalgot, *H.*; Jaipal, *Beng.*

A small tree with elliptic or ovate acuminate, shallowly serrate leaves, with 3–5 basal nerves and somewhat stellately hairy beneath. Clusters of smallish green flowers in terminal sub-glabrous racemes.

"Chota Nagpur," *Wood*, but doubtless only cultivated. It is said to be "frequently cultivated," but I have not seen it in our area, though well acquainted with it in its wild state in the lower Bhotan Himalaya. Fls. June (in Bhotan). Fr. Sept.–Nov. Evergreen.

L. 4–7″, usually caudate and with cuneate base, young, densely stellately pubescent beneath, secondary nerves few, strong, tertiary reticulate. There are 2 large glands on the base of the leaf or above the petiole. Racemes 5–6·5″, sulcate, nearly glabrous or thinly stellately hairy. Petals narrower than sepals, woolly. Stamens many. Female fls. ·25–·3″ diam., petals linear-oblong, shorter than the sepals. Ovary densely stellately strigose Styles long, deeply 2-fid. Fr. stellately hairy, ultimately woody, sub-3-lobed, ·75″ long and broad. Seeds ·5″, black, slightly compressed, ellipsoid, with 8 raised lines.

The source of Croton oil.

3. **C. caudatus,** *Geisel.*

A scrambling or climbing shrub with trunk attaining 2 ft. girth, twigs stellately tomentose or stellately hairy. Leaves ovate or orbicular cordate, 2·5–5″ diam., toothed or crenate-dentate with a stalked deciduous gland at some of the sinuses beneath; base 3-nerved and often with 1–2 weaker nerves. Flowers whitish on 2–3-nate pedicels ·25–·3″ long, in racemes often elongating to 15″, monœcious, the lower 2–6 flowers being usually female. Capsule globose, ·6–·7″ diam., stellately mealy.

Not common, though it often forms a dense undergrowth in Eastern Bengal. Puri, *Draper*! *Hooper*! Fls., Fr. May–July.

L. stellately hairy beneath and on nerves above, stellate hairs between nerves above deciduous leaving copious small raised dots, 2 large stalked glands on either side of petiole beneath, secondary nerves on mid-rib 4–6, tertiaries sub-parallel and strong. Male Fls. villous, with stamens ·25″ long, clustered on the rhachis, oblong petals nearly as long as sepals, woolly. Styles cleft almost to base into two linear arms.

Somewhat resembles *Mallotus repandus.*

4. **C. sparsiflorus,** *Morung.*

A small shrub 2–3 ft. high, with tough branches ribbed with stellate hairs, somewhat resembling *Rivina humilis.* Leaves lanceolate, wavy and toothed, 1–1·7″, sparsely stellately hairy beneath, base 3-nerved. Racemes 2–3″, elongate. Male flowers fascicled, ·1″ diam. in axils of minute bracts. Stamens 12–13. Petals linear-oblong, rather exceeding sepals. Female solitary, with large gland, petals 0, disc of red glands. Ovary densely covered with stellate hairs. Seed carunculate.

Very common near the Mahanadi, Cuttack! Balasore! A native of America, now naturalised, and is very common along the Hughli, near Calcutta. Fls., Fr. May–Sept. and perhaps all the year round.

The plant is somewhat aromatic.

7. TREWIA, *L.*

Trees with opposite (alternate in the seedling) ovate or orbicular, cordate, entire palminerved leaves. Flowers diœcious, apetalous. Males in drooping catkin-like racemes, calyx globose, sepals 3–4, broad concave, stamens many, central, free, anthers dorsifixed, oblong. Female flower larger, solitary, on a long peduncle, or racemose; sepals 3–5, broad, imbricate caducous. Ovary 2–5-celled, styles 2–5, connate below, very long, entire, papillose, or almost fimbriate, ovules 1 in each cell. Fruit drupaceous, with a 2–4–5-celled crustaceous endocarp (or in one species loculicidal). Seeds ovoid, testa hard.

1. **T. nudiflora,** *L.* Bilur, *Th.*; Gambhar, *H.* (from confusion with Gmelina); Gara Loa, *K.*; Gada Lopong, *S.*; Pitalu, Pani-gambhar, *Beng., Or.*

A large tree, superficially much resembling *Gmelina arborea.* Leaves narrow-ovate to broadly ovate, 3–8″ long, on the same twig, with rounded or usually cordate base, green, tomentose or pubescent, or glabrescent beneath, sometimes villosely stellate, with long

petioles 1·5–4″ long. Male racemes drooping, 4–8″ long, with flowers usually in threes, on slender, bracteolate, articulate pedicels; sepals finally reflexed. Female flower solitary or 2–3 terminal, closely invested by the urceolate, 5-toothed calyx, which splits longitudinally; peduncle short, very stout bracteate, attaining 2–3·5″ in fruit. Drupe 1·2–1·5″ diam., globose or ellipsoid, and looking like a small potato when ripe.

Throughout the whole area, but rare in the south-western districts, common in Purneah! Usually along river beds and always so in the drier districts. Fls. Jan.–March. Fr. ripens Oct.–Dec. Leafless Dec. or Jan.–Feb., the fls. usually appearing while the tree is bare.

Bark light grey, old flaking in thin patches. Thin raised stipular lines are visible on the branches and young stems, although the stipules are minute and caducous. These lines may help to distinguish the tree from the pubescent-leaved form of *Gmelina arborea*, the likeness to which in leaf is really remarkable in some specimens. The venation of the leaf, viz. 5–7 basal nerves, 4–6 strong secondary nerves and strong cross-nervules, are much as in *Gmelina*, but the l. lack the small yellow glands beneath, and on the contrary have usually two large glandular areas on the blade above either side of the top of the petiole.

The wood is soft, white, and not durable, but according to *Gamble* is a good one for purposes for which a soft wood is required. It is stated that it is used for drums, but possibly through confusion with *Gmelina*, which is one of the best woods for drums. The weight is given as 28–29 lb. only.

8. MALLOTUS, *Lour.*

Trees or shrubs with opposite or alternate entire toothed or lobed, usually palmately-nerved leaves, often covered with minute round glands beneath and sometimes with glandular areas near the base above: petiole sometimes inserted above the base, stipules often prominent. Fls. small, usually diœcious, apetalous; males clustered, and females solitary, in the bracts of simple or panicled spikes or racemes. Male calyx valvately 3–5-partite, stamens numerous, central, free; anthers dorsifixed, 2-celled; cells globose or shortly oblong, parallel, adnate to and often widely separated by the thickened connective. Female calyx spathaceous or valvately 3–6-lobed or -partite. Ovary 2–4-celled, styles free or connate at base, entire, plumose or papillose, ovules 1 in each cell. Capsule of 2–3 2-valved cocci.

Small tree. L. peltately fixed, 7–9-nerved . . . . . . 1. *Roxburghianus.*
Small tree. L. basally fixed, 3-nerved . . . . 2. *philippinensis.*
Large sarmentose or scandent shrub . . . . . . 3. *repandus.*

1. **M. Roxburghianus,** *Muell.* Barui, *S.*; Dopsinga, *Mal. P.*

A small tree, softly pubescent, with simple and stellate hairs all over, long-petioled, orbicular or broadly ovate, peltately-attached, sinuate, dentate, or denticulate leaves 4–7″ diam. and terminal racemes as long as the leaves. Capsule densely echinate and glandular.

Santal Parganas, in ravines, rare! Fl. May–June. Fr. Aug.–Sept.

L. stellately hairy and with yellow glands both sides, densely so beneath, above sparsely but also with simple hairs, secondary nerves 4–5, tertiaries scalariform. Petiole 1·5–4″. Stipules linear, ·5″. Male sepals 2–5.

2. **M. philippinensis,** *Muell.* Gara Sinduri, *K.*; Rora, *S.*; Rori, *Kharw.*; Kamala, *H.*; Daosindra, *Mal P.*

A tree, 20–30 ft., branched low, with ovate or rhomboid, acute

or acuminate leaves, covered beneath when young, as are the shoots, with a greenish-yellow glandular pubescence, and permanently with small red glands. Male flowers clustered in racemes 6–10″ long. Female racemes 2–3″ long. Capsule smooth but densely covered with red glands.

Throughout the area, especially in moist ground! Fl. Oct.–Nov. Fr. Feb.–March. Evergreen.

Bark nearly smooth, grey, blaze red. L. 3–6″, or some attaining 9″ by 5″, sometimes ovate and slightly toothed by the excurrent nerves, old l. often hoary beneath with fine stellate tomentum, glabrescent above, base 3-nerved, secondary nerves 3–4, with strong transverse tertiaries. Petiole 2–3·5″, thickened both ends. Male racemes axillary and densely panicled at the end of the branchlets. Fls. whitish-yellow, ·12″ diam. Stamens 20–30, anther-cells longitudinally dehiscent, sometimes with a few red glands. Female fls. distant, rarely 2 together, perianth 4-fid, ovary tomentose and red-glandular, stigmas 3, spreading yellow. Capsule ·3–·5″ diam. Seeds globose, smooth, black.

Wood not much used except as fuel. It coppices well and is frost-hardy. The red glands from the capsule are the source of the Kamela dye, and is met with in the bazaars as a purplish-red powder, used especially for silk. It is also used as a remedy for tape-worm.

3. **M. repandus,** *Muell.* Syn. Rottlera tricocca, *Roxb.*; Ghirguria, *Or.*

A large scandent or subscandent shrub with long thorns on the trunk. Branches tomentose. Leaves ovate with cordate straight or retuse base, rarely obtuse or rhomboid at base, acute, scarcely acuminate, entire or somewhat sinuate and some of the nerves excurrent as minute teeth, 2–4″ long by 1·8–3·5″ broad, softly stellate-pubescent and closely covered with small glands beneath, glabrescent above. Flowers in terminal panicled racemes in the male with 3–5 yellow, suborbicular or lanceolate concave tomentose sepals ·12″ long, glandular within; anthers with 2 oblong cells slightly produced beyond the connective. Female flowers green, in simple racemes, sepals linear, soon deciduous, ovary very tomentose, 2-lobed and -celled, stigmas plumose, sessile. Cocci globose glandular, ·2″ diam.

In the damper regions only, Champaran! Purneah, common! Santal Parganas and Monghyr, towards the Ganges! Dalbhum, *Gamble*! Puri, very common in the damper parts! Angul! Fl. Jan.–Feb. Fr. March–April.

L. with 2–3 secondary nerves above the 3-nerved base, tertiaries sub-parallel, petiole 1–2″ long, stipules minute, tomentose. Capsule densely fulvous tomentose, seeds subglobose.

9. MACARANGA, *Thouars.*

Trees or shrubs with most of the characters of *Mallotus*, from which genus they are somewhat artificially separated by the stamens. These are 1-many with flexuous filaments and are always supposed to have 3–4-locellate anthers with the cells more or less 2-valved. The anthers are, however, variable; in some species they open by 4 valves like the 4-valvate sepals of a flower; usually they have 3–4 2-valved terminal cells, but sometimes (*e.g. M. indica*) only 2 cells occur on the same plant as 4-celled anthers, and then these resemble a *Mallotus* except by the smaller connective and more apical slits. Female flowers one to few in a bract, calyx 2–4-lobed or -toothed. Ovary 1–6-celled (1–2-celled in our species), with as many cocci in fruit.

L. peltately attached above the base in all.

I. Floral bracts of male narrow, not concealing the fls. Female with narrow styles and stigmas.
  - Stamens 6–30. Ovary 2-celled, stigmas 2 terminal . . . 1. *denticulata.*
  - Stamens 6–10. Ovary mostly 1-celled, stigma 1 lateral . . . 2. *indica.*

II. Floral bracts very broad, concealing the male fls. Female with peltate lateral stigma . . . . 3. *peltata.*

1. **M. denticulata,** *Muell.* Mallota, *Nep.*

A small tree with a low crown of deltoid-ovate light green leaves 4–12″ long, whitish and closely covered with minute glands beneath. Male panicles 3–4″ long, pyramidal, with small, sub-orbicular, or broadly ovate bracts only ·06–·07″ long, with broad sessile base. Female panicles densely branched, 1·5–2·5″ long, with oblong deciduous bracts leaving a prominent scar; flowers usually paired in the lower bracts with stout pedicels, sepals 2–3″, broadly-ovate, ovary 2-celled, closely covered with yellow glands; stylar column short and stout with 2-curved stout subulate stigmas. Capsule ·25″ diam., didymous.

North Purneah, on the borders of the Sikkim Tarai only! Fls. April. Fr. July. Evergreen.

Stem with quite smooth light-coloured bark. Shoots brown, tomentose. L. with 3 strong principal nerves and about 6 other basal ones, secondary nerves 9–12, strong, parallel, with the two lateral principal nerves running nearly to margin and then bifurcating, each short branch ending in a gland or (in the young l.) in a tooth, the margin sometimes permanently denticulate; tertiary nerves close scalariform, base of leaf usually rounded or somewhat retuse, apex sharply acuminate or obtuse. Stipules lanceolate, caducous.

The tree has been found useful in the Duars in reclaiming Savannah tracts.

2. **M. indica,** *Wight.*

A quick-growing tree up to 5 ft. girth and 50 ft. high with green or glaucous branchlets, large broadly ovate or sub-orbicular leaves 6–13″ long, glaucous and glandular beneath. Male panicles 3–4″ long with zig-zag branches bearing stipitate bracts, the lower foliaceous, the upper with blade modified into a large gland and cuspidate. Female panicles pyramidally branched, 3″ long, hairy, flowers 1–3 at the nodes, on pedicels ·2–·4″ long, sepals triangular, acute. Ovary shortly hairy and densely glandular, mostly 1-celled, with a lateral sessile, long subulate stigma. Capsule 1-coccous, globose, ·25″ diam.

Ravines in the hills of Singbhum, rare! Fl. Sept.-Oct. Fr. Oct.-Nov.

Juice very gummy. Branchlets robust, shoots tomentose. Nervation much as in *denticulata*, but the 7–10 secondary nerves more curved within the margin and giving off very short nervules, which run into the marginal teeth or glands; these glands glabrous; large elliptic glandular areas also frequently occur on the upper surface along some of the basal nerves. Stipules ·5″, ovate, ciliate, caducous.

There is some doubt about the occurrence of this tree, which I have described from Sikkim specimens collected at 4000 ft. elevation. My specimens collected in Singbhum were sent to Sir Dietrich Brandis, and were referred by him to *M. indica* (*Indian Trees*, p. 592), but other specimens from the same forest are *M. peltata* (*q.v.*)

3. **M. peltata,** *Muell. Arg.* Syn. M. Roxburghii, *F.B.I.*; Osyris peltata, *Roxb.*; Piania, Gondaguria, *Or.*; Tabhari (Mayurbhanj).

A small or moderate-sized tree with green branches and glandular twigs, large, peltate, orbicular-ovate acuminate leaves mostly 4–9″ long, densely tomentose when young and permanently more or less

hairy on the nerves beneath, and with numerous minute glands between the nerves; somewhat rusty above. Male panicles 3–4″ long, but rather strict, bearing large tomentose bracts, foliaceous at the base of the branches, transversely oblong or orbicular and denticulate, concealing the flower-clusters; bracts ·15–·3″ broad according to position, shortly stipitate. Female flowers in nearly simple racemes or these branched at the base, 1·2″ long, also with large rusty tomentose deciduous bracts; flowers on long pedicels ·25–·6″ long, sepals very minute, rounded. Ovary densely covered with glands glabrous or only slightly puberulous, bearing a lateral sessile, broadly-peltate papillose stigma. Capsule globose, ·3″ diam., often grooved, with deciduous yellow glands. Seed 1, globose, black.

Singbhum, in deep valleys, very rare! Mayurbhanj! Puri, frequent! Angul, common! Fls. March. Fr. April. Evergreen.

Branches exuding large quantities of gummy sap when cut as in the last species. L. attain 12″ in length, the nervation as in the last species, but the small nerves running into the margin ending usually in hirsute glands; upper surface dull, not shining. The Singbhum form is rather different in that the nervules below are much more raised and the marginal glands glabrous. Petiole usually 3–8″, sometimes 15″. Stipules ovate to oblong or ovate-lanceolate, or in the Singbhum form lanceolate and over ·5″ long. Panicles mostly from the axils of fallen leaves. Anthers 4-valved.

A rapidly growing soft-wooded tree, soon overtopping the Teak in the Puri plantations.

10. CLEIDION, *Blume*.

Glabrous trees with alternate, toothed, penninerved leaves. Fls. monœcious or diœcious, males in long axillary racemes, females 1–2 on a long axillary peduncle. Male calyx globose, valvately 3–4-sepalous, stamens over 20, free, very close, central; anthers dorsifixed, 4-celled, or with 2 cells only transversly didymous on the margins of a broad connective. Female sepals 3–5, imbricate. Ovary 2–4-celled, styles connate below with 2–3 long filiform arms, cells 1-ovuled. Capsule of 1–3 2-valved cocci. Seeds subglobose.

1. C. javanicum, *Blume*.

A small tree with narrowly elliptic-lanceolate to obovate-oblong acuminate, coarsely sharply serrate leaves, 3–8″ long, with a long petiole 1·3–3·5″, thickened both ends. Male flowers in clusters of 2–5 on slender spikes or racemes 2–6″ long, sepals 3, triangular. Females solitary, the peduncle often swollen above, styles 3–4, very long, ·75″. Fruit mostly 3-coccous, ·8–1″ diam. and ·4″ long on a peduncle 2–4″. Seeds ·3–·5 diam., globose, smooth.

Near streams, rare. Ramnagar forests! Fls. Dec.–Jan. Fr. Feb.–March. Evergreen.

Bark grey, corky, blaze with chlorophyll. L. somewhat repand with the teeth often incurved, secondary nerves 5–7 strong but fine beneath, tertiaries numerous, close, reticulate between. Thickened ends of petiole and peduncle transversely rugose when dry. Raceme sometimes pubescent, bracts minute.

11. LASIOCOCCA, *Hook. f.*

Small trees with subverticillate, more rarely alternate or sub-opposite, shortly petioled oblanceolate or obovate leaves, entire with cordate base. Fls. monœcious or diœcious, males racemose, females

solitary, peduncled, axillary or sub-corymbose at the apices of the new shoots. Male flower with globose calyx, valvately 3-partite, stamens numerous, connate into a much-branched column, the branches with numerous anthers with 2 globose anther-cells, connective large. Female flower with 5–7 unequal sepals, persistent and somewhat accrescent. Ovary globose or slightly 3-lobed, scaly or tubercled; styles 3, filiform erect, stigmatose on the inner side. Ovules 1 in each cell. Capsule finally 3-coccous, deciduous from a 3-cornered columella covered with stout bristles, hard conical points or tubercles. Seeds sub-globose, smooth, with thin crustaceous testa, raphe linear, albumen fleshy, cotyledons large orbicular, subcordate, thin.

1. **L. Comberi,** *Haines* (*Kew Bulletin*, 1920, No. 2.) Kukri-hari, *Or.*

A small tree, with bushy crown, white twigs and sub-verticillate obovate, cordate-based or panduriform leaves 3–7″ long, with usually caudate tip, glabrous, margin rather wavy-cartilaginous, secondary nerves 10–13, rather strong, petiole tomentose, very short. Male racemes 1–2·25″ long, axillary and from the axils of fallen leaves, pedicels very short, articulate, calyx pubescent only at the tip in bud, sepals elliptic-oblong, ·12–·13″. Female peduncles pubescent, ·6–1″ long, in the axils of the terminal leaves or sub-corymbose in the axils of bracts, sepals unequal; mostly broadly ovate acuminate, inner narrower or linear, glabrous except a few ciliolæ. Ovary tubercled, each tubercle with a simple seta. Capsule ·5″ diam., depressed, tubercled. Seed globose, brown.

Rocky ravines and nalas. Puri (Dhuanali forest, common)! Angul! Mountains of Mayurbhanj! Fl. June. Fr. Aug.–Sept. Evergreen.

Stem often buttressed, bark pale or white, blaze hard, brown and white. New shoots densely pubescent. Buds rusty tomentose, ·1–·25″ long. Tertiary nerves fine scalariform, and upper surface of l. microscopically pitted, pits sometimes visible as translucent dots. An inflorescence-like growth is sometimes produced by galls.

12. HOMONOIA, *Lour.*

Shrubs with alternate, entire, or toothed leaves, lepidote beneath. Flowers usually diœcious, bracteate and 2-bracteolate in axillary spikes rarely, sometimes reduced to single flowers. Male with globose calyx splitting into 3-valvate sepals, stamens united into a central column, which is divided into numerous branches and finally dense clusters of 2-celled anthers, with a very minute connective. Female sepals 5–8, narrower imbricate, inner sometimes smaller, deciduous. Ovary 3-celled with 3 spreading entire papillose or almost fimbriate styles. Capsule small, of 3 usually tomentose 2-valved cocci, not scaly or tubercled. Seeds ovoid with a thin fleshy coat.

A. Female fls. in slender spikes as long as the male.
  L. linear to linear-oblong, entire or serrulate . . . . 1. *riparia.*
B. Female fls. subsolitary or in short spikes. L. toothed.
  L. oblong to obovate, 1·5–3·5″. Outer female sepals ·14″ . 2. *intermedia.*
  L. cuneate-obovate, ·7–1·5″ Female sepals equal, ·07″ . . 3. *retusa.*

1. **H. riparia,** *Lour.* Syn. Adelia nereifolia, *Roth.* (and in *F.I.*); Garahuru, *M.*; Sunukui, Gurjor, *S.*; Jamla, *Or.*

A large rigid shrub with numerous erect stems marked with

prominent leaf-scars, tomentose above. Leaves linear, linear-lanceolate or linear-oblong, willow-like, 3–10″ long by ·3–1″ broad, entire, or with wavy margins, or sometimes toothed or serrulate towards the tip, closely pubescent on the nerves beneath. Male spikes 1·5–4″ long with tomentose rhachis; bract ·04–·05″, ovate acuminate, bracteoles smaller, lanceolate. Female spikes 2–3″, bracts as in the male, rhachis grey tomentose, sepals lanceolate, 5–6, ·07″ long, nearly equal, pubescent. Ovary tomentose. Capsule tomentose ·2–·25″ diam., seeds bright crimson.

Rocky river-beds, throughout the area but somewhat local! Fl. March–April with the young shoots. Fr. May–Sept. Usually described as evergreen, but it is often completely deciduous in cold weather.

Secondary nerves of leaf very numerous, sometimes over 30, but dependent on the size of l.; other nerves sometimes much raised, leaving deep areoles between them, in other forms not much raised. Petiole ·25–·3″. Stipules linear, ·24″, deciduous. Male sepals nearly glabrous, elliptic, ·13″.

2. **H. intermedia,** *Haines.*

A shrub with many erect branches and stout, usually red, minutely pubescent twigs. Leaves mostly 2–4·5″, sometimes only 1″ on abbreviated shoots, oblong with somewhat attenuated base, rarely obovate, with usually rounded, obtuse or acute tip, serrate or coarsely serrate, somewhat pubescent on the nerves beneath when young; secondary nerves 7–8, petiole ·1–·15″. Male spikes not seen. Female spikes 4–7″ with pink pubescent rhachis, bract and bracteoles subequal, acuminate, ·11″ long, sepals lanceolate, outer 3 larger, red, ·14″, styles more fimbriate, ·07–08″.

Mahanadi river bed! Fl. March.

This plant, which for want of the male spikes I have not elsewhere described, is almost intermediate in leaf between *riparia* and *retusa*, and it might possibly be a hybrid. It has the female fls. almost twice the size of the other two species. Treated as a variety of either it would be very difficult to know to which to assign it.

3. **H. retusa,** *Muell. Arg.*

A smaller shrub than *riparia* with obovate l., 1–2″, usually cuneate at base, rounded or retuse at tip and usually serrate-dentate, beneath glabrous, and with fewer scales than in *riparia* and only about 5–6 secondary nerves. Male spikes ·5–1″ long, stout. Female fls. sub-solitary or in spikes ·5″ long, with pink pubescent rhachis closely resembling *intermedia*, but fls. only as large as in *riparia*. Sepals of male glabrous, of female minutely pubescent. Capsule ·1–·15″ diam.

This, which has been described from specimens from the Central Provinces for purposes of comparison with *intermedia*, has not been found in our area.

13. RICINUS, *L.* Castor-oil.

A tall stout herb, or perennial and sub-arboreous, with large, orbicular, palmately-lobed and serrate leaves. Flowers in terminal, subpanicled racemes, monœcious. Males crowded in the upper parts of the racemes, calyx splitting into 3–5 valvate segments, stamens very many, connate in several branched columns, anthers clustered on the final branches, cells distinct, subglobose on the rather large connective. Female fl. large, in the lower part of the raceme, calyx spathaceous, caducous. Ovary 3-celled, styles spreading, entire, 2-fid or 2-partite, feathery or papillose, often very large and brightly

coloured. Ovules 1 in each cell. Capsule of 3 2-valved cocci. Seeds oblong, with large caruncle and crustaceous testa.

1. **R. communis,** *L.* Arandi, *H.*; Bheranda, *Beng.*; Jara Bindi, *K.*

This is the well-known *Castor oil* plant, which is cultivated under two common forms: (1) A perennial with stems woody below with large fruits and large red seeds, said to yield about 40 per cent. of oil, used chiefly for lubricating and illumination (*Nadkarni*), and (2) an annual grown as a crop with small grey and brown mottled seeds yielding rather less oil of better quality for medicinal purposes. The seeds contain a toxic, extremely poisonous substance, "ricin," which is, however, not contained in the oil. (3) var. *Gibsonii*, which large purple bronze leaves, is grown as an ornamental plant only. Müller distinguishes 17 varieties. De Candolle states that its cultivation is extremely ancient, and considers its home was originally in Abyssinia, Sennaar and Kordofan.

14. CLAOXYLON, *A. Juss.*

Herbs (in our area), or usually trees or shrubs, with long-petioled, entire or toothed, penninerved or sub-palmately-nerved leaves. Flowers small or minute, monœcious or diœcious, in sometimes very slender spikes or racemes. Calyx subglobose, of 3–4 valvate segments, petals 0, disc 0 or of 3 petal-like hypogynous scales alternate with the carpels. Stamens many, or few, on or around a central receptacle often intermixed with glands or linear scales, anther cells distinct, free above and erect. Ovary 3-celled, styles entire, spreading, fringed, ovules one in each cell. Capsule of 3 2-valved cocci or indehiscent. Seeds sub-globose, testa crustaceous, sometimes arillate or verrucose, albumen fleshy, cotyledons broad, flat.

1. **C. mercurialis,** *Thw.* Syn. Tragia mercurialis, *Willd.*

An erect, weedy annual 12–24″ high with pale sub-glabrous stems, long-petioled, ovate or rhomboid, acuminate-crenate or serrate leaves 1–3″ long, and numerous capillary racemes 2–3″ long, bearing distant clusters of minute subsessile or shortly-pedicelled males and slender-pedicelled larger females ·07″ diam. Sepals 3, distant lanceolate, scales 3, shorter, ligulate or sub-terete. Capsule ·17″, deeply 3-lobed, depressed, pilose. Seeds pitted or verrucose.

Monghyr, *Ham.*! Orissa, near the coast (Konarak)! Fl., Fr. Aug.–Sept.

L. glabrous with a matt surface, sometimes obtuse (*teste F.B.I.*), base cuneate, rarely with a slight cordation or obtuse on the 1–1·7″-long petiole; 3–5-nerved, but with lateral basal nerves slender; secondary nerves 3–4. Bract at the flower-clusters very small. Male fl. most minute, with only 2–3 stamens (often 5–10, *teste F.B.I.*); filaments very short, anther-cells short, erect, parallel.

15. ACALYPHA, *L.*

Herbs, shrubs or trees, with alternate, toothed or crenate, rarely entire leaves, and minute flowers, monœcious, rarely diœcious, apetalous, in axillary or terminal racemes, with the females at the base of the rhachis and bracteate, with the more minute males ebracteate, or females separate, 1–2 in a peduncled solitary bract or in separate

bracteate spikes. Male with 4-valvate membranous sepals, disc 0, stamens 8–many on a convex receptacle, anther cells divaricate, often flexuose or twisted, pistillode 0. Female flowers with 3–4 imbricate sepals, ovary 3-celled, styles filiform, often very long and laciniate or fimbriate. Ovary 3-celled, ovules 1 in each cell. Capsule of 3 minute 2-valved cocci. Seed subglobose.

Herbs with males and females on the same spikes in our species.
Female bracts dentate or crenate . . . . 1. *indica*.
Female bracts almost pectinate, with long, hispid teeth . . . 2. *ciliata*.

A large genus, widely spread in the tropics of both hemispheres, and of which several handsome shrubs with variegated and copper-coloured leaves are found in all Indian gardens.

1. **A. indica,** *L.*

A stiff erect herb, 18″–2·5 ft. high with puberulous stems, spreading, long-petioled, rhomboid-ovate, serrate leaves, and very numerous axillary spikes with foliaceous concave sub-orbicular-cuneiform many-nerved toothed bracts, bearing green female flowers in the lower part of the spike, the top of the spike being male and ebracteate. Capsule concealed by the bract, hispid, usually 1-seeded.

Northern Bengal (possibly Purneah), *Kurz*! Hazaribagh, near Chorparan, etc.! Puri, near Balugaon, *Hooper*! Fls., Fr. c.s.

L. 2–2·5″, with a 5-nerved cuneate entire base, margin somewhat ciliate, apex obtuse toothed, surface minutely dotted, petiole longer than the blade, pubescent. Spikes 1·5–2·5″, several in one axil or on short axillary branchlets; female bracts with a nerve to each tooth and bearing one to a succession of fls.; perianth of 3 minute hyaline scales with gland-tipped ciliæ. Ovary 3-lobed with curly pubescence, style arms with 3 slender branches. Male fls. very minute, clustered, with 4-lobed perianth, buds 4-angled, stamens with curved swollen hyaline filaments and 2 erect slender cells.

2. **A. ciliata,** *Forsk.*

An erect, rather stout, glabrous or pubescent herb 1–2 ft. high, with long-petioled ovate or ovate-lanceolate, acuminate serrate leaves 2–3″ long, with rounded or cuneate base and petiole usually longer than the blade. Spikes rarely 1″ long, with the female bracts almost tubular, crowded, with many nerves ending in long subulate, hispid teeth as long as the limb, each with 1–2 flowers. Male flowers few, very minute at the end of the spike. Ovary sparsely hispid. Capsule glabrous, cocci very thin white.

Behar, *Kurz*! Fls., Fr. July–Dec.

16. GELONIUM, *Roxb.*

Small glabrous trees or shrubs, the branches with stipular lines at the nodes. Leaves sometimes opposite, pellucid punctulate, entire or serrate, with connate, sheathing, caducous stipules. Flowers axillary, cymose or clustered, diœcious. Male sepals 5, orbicular, imbricate, stamens 10–60, free central, anthers oblong dorsifixed, cells parallel, introrse. Female flowers sepals 5–6, usually narrower than in the male, disc cupular or annular, sometimes with staminodes. Ovary 2–4-celled, styles minute, stigmas reniform, semi-lunate or 2-fid, ovules 1 in each cell. Fruit 3–4-gonous or 2–4-lobed, fleshy, coriaceous or crustaceous, tardily dehiscent. Seeds subglobose, arillate.

Fls. in contracted cymes. Male ·4–·5″ diam. Female sepals ·15″ in fl., ·2–·25″ in fr. Fr. ·7–·9″ . . . . 1. *multiflorum*.
Fls. fewer fascicled. Male fl. ·2″ diam. Female 1–4 together only, sepals ·1″ in fl., scarcely accrescent. Fr. ·4″ . . . 2. *lanceolatum*.

1. **G. multiflorum,** *A. Juss.* Khakra, Kukra, *Or.*; Ganari, *Gond.*

A small straight tree with green twigs prominently marked by the pale stipular scars and with very resinous buds. Leaves 3–6″, elliptic-oblong or sometimes oblanceolate-obtuse, or few acute, some somewhat serrate, more or less cuneate on the ·1–·25″-long petiole. Flowers usually in contracted cymes, more rarely merely clustered. Males very sweet scented, yellow from the large, yellow, honeyed receptacle and anthers, ·4–·5″ diam. including the many stamens; sepals 5, reflexed, ·17–·2″, broadly oblong, obtuse, often concave and with somewhat minutely-ragged hyaline margins. Stamens 40–70. Female sepals pubescent, orbicular or broadly oblong, ·15″, soon enlarging to ·2″ or ·25″ in fruit; disc annular, rough, with rudimentary staminodes (?), stigmas flabellately lobed. Fruit ·7–9″, slightly 3-gonous and 3-grooved.

More or less evergreen forest round the eastern, damper side of the province. Purneah! Santal Parganas, rare! Puri, common! Angul, common! Nilghiri! Mayurbhanj! Fls. March–April. Fr. April–June.

Bark nearly smooth. L. with 5–10 oblique secondary nerves, reticulate between, fine, slightly raised above, translucent dots not clear and often diffused, sometimes slightly raised on the dry leaf. The fr. in some specimens is somewhat tubercled, but I have only seen smooth frs. in our area.

2. **G. lanceolatum,** *Willd.* Same vernacular names.

A small, straight, much-branched tree, closely resembling the last in habit and foliage, but leaves usually smaller, 1·5–·4″, rarely up to 6″, nearly always more or less obovate or oblanceolate, sometimes elliptic-obovate to oblong, shining both sides and coriaceous (as in last). Petiole ·1–·2″. Male flower in small fascicles, not cymose, only ·2″ diam. including the stamens, which are usually under 40, sepals orbicular, erect, ·07–·1″, receptacle not swollen. Female flower solitary or 2–4 together, sepals broadly ovate, ·1″, and scarcely larger in fruit. Stigmas 2-fid with incurved subulate arms, which are somewhat toothed. Disc thinner, more cupular and less pulvinate than in *multiflorum* and without staminodes. Capsule ·3–·4″ with the lobes keeled.

Mals of Puri! Fls. usually a few weeks later than *multiflorum*. Also a flowering specimen (*Lace*) in November.

Bark smoothish grey-brown, blaze rather hard flesh-coloured. The translucent dots sometimes barely visible. Hooker states that the fls. are sometimes in short racemes, of which the rhachis is covered with imbricating bracteoles, and that the capsules are rough. Seeds globose, ·12–·17″ diam., testa with large shallow pits.

17. BALIOSPERMUM, *Blume.*

Shrubs or undershrubs with alternate, sinuate, dentate or lobed leaves, penni-nerved or palmi-nerved; base 2-glandular. Flowers small, monœcious or diœcious, fascicled, racemed or panicled. Male sepals 4–6, orbicular, concave, imbricate, disc of 4–6 glands, stamens 10–30 on a small receptacle, filaments free or few connate, anther-cells

parallel, adnate to a broad connective. Female sepals 5–6, lanceolate, sometimes accrescent in fruit, disc entire. Ovary 3-celled, styles rather long, stout, 2-fid or 2-partite, with smooth stigmatic surfaces, cells 1-ovuled. Capsule of 3 2-valved crustaceous cocci. Seeds ovoid.

1. **B. montanum,** *Muell.* Syn. B. axillare, *Bl.*; Jatropha montana, *Willd.*

A shrub or undershrub with numerous, erect, herbaceous shoots from the perennial rootstock, with variously lobed. lobulate, sinuate or serrate leaves, lowest sometimes palmately-lobed and broad, mostly elliptic-oblong, becoming lanceolate above, often attaining 6–10″ long below. Fls. green, fascicled, axillary and in the axils of bracts on proliferous shoots or in contracted leafless panicles. Capsule 3-lobed, ·3–·4″ long, pubescent. Seeds with a brown caruncle.

Usually in undergrowth in damp places. Purneah and Santal Parganas! Singbhum and Palamau! Parasnath, *Prain*! Angul, very common! Fls. chiefly Dec.-March.

Attains 6 ft. in Angul with weak stems, more or less strigose or twigs pubescent. L. with 3–5 nerves at or near the base. Fls. said to be monœcious in the type.

Var. **dioica,** *Haines* (*F.C.N. & Indian Trees*, p. 583).

Leaves with very strong tertiary nerves. Fls. diœcious, males fascicled in narrow panicles, and the females 1–3 axillary. The common form in our area.

18. TRAGIA, *L.*

Usually climbing herbs, hispid, with pungent or stinging hairs. Leaves alternate, simple or palmately 3-lobed, with often cordate base, palmately nerved. Flowers minute, monœcious, racemose, males several in the upper parts of the racemes, females solitary or few, in the lower parts. Male calyx valvately 3–5-sepalous, stamens 1–3, rarely more, filaments free or connate, anther-cells contiguous, parallel. Female sepals 6, much larger than in the male, imbricate, sometimes pinnatifid and accrescent. Styles 3-fid with spreading entire arms. Capsule of 3 2-valved cocci. Seeds globose.

Female sepals accrescent pectinate, hirsute . . . . . . 1. *involucrata*.
Female sepals not accrescent, entire, puberulous . . . . . 2. *Gagei*.

1. **T. involucrata,** *L.* Jipenda, *Ho.*; Sengel-sing, *K.*, *S.*; Barhanta, *H.*; Bichati, *Beng.*, *Or.*

A stout herb, woody below, and with a perennial stock, with sub-erect or twining branches, puberulous and villous as well as with scattered pungent hairs. Leaves 1–4·5″, oblong, ovate-oblong, elliptic or rhomboid acuminate, base usually rounded, sharply serrate, young almost tomentose beneath, old hairy and setose. Flowers usually in leaf-opposed sub-spicate racemes, sometimes racemes terminal or on short axillary branches. Male sepals ·05″, broadly ovate. Stamens 3, sometimes 2-branched, each branch with an anther. Female sepals linear with long, glandular, hirsute teeth or lobes, hardened in fruit and spreading, ·2–·3″ long, ovary villous. Capsule ·3″ diam., usually hirsute. Seed globose, purple black, strophiolate, slightly under ·2″, mottled with thin white scales.

Waste places and hedges, often among rocks. Chota Nagpur! Santal Parganas! Puri! to Kalahandi! Fls., Fr. Dec.–April.

Leaf 3–5-nerved and with 3–4 secondary nerves and fine cross tertiaries. Petiole ·7–1″. Stipules lanceolate, ·1–·2″. Spikes or racemes ·3–1″, upper male portion with close oblanceolate stipitate bracts about ·06″ long.

2. **T. Gagei,** *Haines*, in *Journ. As. Soc. Beng.*, xv, p. 7.

A slender twining herb with brown, slightly pilose branches. Leaves oblong, 4–5″ long, abruptly acuminate with cordate base, margin shallowly dentate-serrate, beneath almost glabrous even when young, above slightly setose, base 5–7-nerved, secondary nerves about 3, tertiaries reticulate. Male sepals 4, oblong acute. Stamens 2, anthers broader than long. Female sepals oblong-oblanceolate, acute, scarcely ·1″ long in fruit, entire puberulous outside, glabrous within. Capsule hispid, ·3″, seeds globose, ·2″, quite smooth, marbled brown and white, not at all strophiolate or tumid at the chalaza.

Mals of Puri! Fls., Fr. March–May.

Scarcely stinging. Petiole 1·2–1·5″ long, slightly thickened both ends, villous when young. Stipules triangular, ·07″. Bracts on the racemes, ovate, ·05″, or shorter below the male fls., almost glabrous except the margins.

19. SAPIUM, *P. Br.*

Trees or shrubs with milky juice, entire or toothed penninerved leaves, petiole often 2-glandular at the top. Flowers in terminal spikes or racemes, monœcious. Males several in each bract, calyx shortly 2–3-lobed or -toothed or valvately 3-sepalous, stamens 2–3, free, anther-cells parallel. Female flowers usually at the base of the spikes, solitary in each bract, or spikes unisexual, calyx 3-fid or -partite, ovary 2–3-celled, styles sometimes connate at base, spreading, simple, cells 1-ovuled. Fruit crustaceous, fleshy or rarely woody, tardily loculicidally 3-valved. Seeds globose, usually long-persistent on the columella.

Spikes androgynous. L. rhomboid . . . . 1. *sebiferum.*
Spikes unisexual. L. large, elliptic-lanceolate . . . . . . 2. *insigne.*

1. **S. sebiferum,** *Roxb.* Momchina, *Beng.*; Bilaiti-sissu, *Vern.*; Chinese Tallow Tree.

A small glabrous tree somewhat resembling *Sissu*, the leaves being of much the same shape as *Sissu* leaflets, broadly rhomboid, 1·5–3″ long with a short or long acumen, sometimes broader than long, base 3-nerved, of which the lateral are sometimes marginal, two glands at the junction of blade and the 1·5–3″ slender petiole. Racemes terminal, 2–5″ long, with small rhomboid bracts and large gland either side of each bract; some racemes male with barren bracts below, others with a few female flowers below and the rest male. Females with pedicels ·2–·4″ long and long linear styles connate about half-way. Males several in a bract, more shortly unequally pedicelled, yellow, calyx cupular, toothed or truncate, anthers large, broader than long. Capsule coriaceous, ·25″, seeds with a coating of wax under the epidermis.

A native of China, very commonly planted, and more or less naturalised in

Purneah. Fls. Aug.–Sept. The open capsules may remain on the tree until November. Deciduous Nov.–March in the dryer districts, turning red before falling.

Growth very fast and tree ornamental. The source of the vegetable tallow of China. Roxburgh considers that cocoa-nut oil is superior to it for burning.

2. **S. insigne,** *Benth.*

A small tree with thick, pale brown, succulent branchlets and rather fleshy large leaves crowded at their ends. Leaves elliptic-lanceolate, acuminate or finely caudate, 6–10″, crenate, base narrowed into the 1–1·7″ petiole, which is 2-glandular above. Stipules very small, finely acuminate with glandular base. Male flowers in round clusters on the stout fleshy rhachis of solitary terminal spikes, 3–6″ long. Female flowers sessile (or shortly pedicelled, *f. F.B.I.*), in similar spikes but not clustered, rarely spikes 2-sexual. Ovary ovoid. Fruit ovoid or broader than long, ·3–·4″.

Very rare. On rocky aspects on the highest mountains of Mayurbhanj, elevation above 2000 ft.! Fls. Dec.–Feb. Fr. March. Deciduous, renews L. March–May.

Blaze pale with much milky juice. Crenations of leaf at first serrate with deciduous glandular tips. Secondary nerves about 12, rather strong, oblique.

This is one of the numerous cases of a Himalayan and Chittagong plant being found in Orissa. The tree has, however, also been collected from Southern India and Malabar, presumably from the mountains.

20. EXCŒCARIA, *L.*

Glabrous trees or shrubs with acrid milky juice and alternate or opposite leaves. Flowers in bracteate spikes or racemes, monœcious or diœcious, very small, rhachis with large glands. Male flowers 1–3 in each bract, sepals 3–5, stamens 3, free, with didymous anthers. Female flowers sometimes on the lower part of the male spikes, sometimes on distinct racemes or spikes, calyx 3-fid or -partite. Ovary with 3 stout, spreading, or recurved styles, cells 1-ovuled. Capsule of 3 cocci separating from a columella. Seeds subglobose, estrophiolate.

1. **E. agallocha,** *L.* Gowan, *Or.*; Gengwa, *Beng.*

A small tree or large shrub with much milky juice, numerous erect stems or branches, well clothed with coriaceous, long-petioled, entire or sinuate-crenate ovate lanceolate, ovate or orbicular leaves, 2–3″ long, the old ones deep red (before falling). Male flowers in catkin-like spikes, 1·5–2·5″ long, from the upper axils or from the axils of fallen leaves. Female spikes or racemes fewer, ·5–1″, on separate trees. Fruit deeply 3-lobed, depressed, ·6″ diam.

Muddy ditches near the sea, Balasore! Tidal forests, Cuttack! Fls. May–June with the new leaves. Fr. May–June. The old L. drop at the time of the new flowering.

L. with rounded base and short acuminate tip. Secondary nerves 5–8, rather obscure, spreading, petiole ·5–1″, 2-glandular at junction with blade. Male bracts rounded, 0·7″ broad; fl. sessile or pedicelled, bracteolate; sepals very minute, lanceolate with incurved very acute tip and minutely toothed; anthers far exserted, with small connective and two large ellipsoid cells. Female bracts cuspidate, fls. sometimes subsessile, sepals larger than in male, ovate cuspidate, ·05″. Styles 3, revolute.

In a specimen collected by *Bourne* there is one twig with male racemes and immature leaves and another with capsules and mature L., which, he says, were

"collected from the same tree." Hooker says the variations in the size of fr. and seeds is remarkable.

The juice causes blisters and bad sores. Gamble gives weight of wood as 24 lb. only.

21. SEBASTIANIA, *Spreng.*

Shrubs or (in our species) a herb with alternate penninerved leaves and minute monœcious flowers in slender racemes. Males 1–3 in each bract, calyx unequally 5-lobed or -partite, stamens 2–4, anther-cells distinct but contiguous. Females solitary or at the base of the male racemes, calyx 3-lobed or -partite, ovary 3-celled, styles revolute or spreading, sometimes connate at base. Capsule of 3 cocci separating from a columella. Seeds strophiolate.

1. **S. chamælea,** *Muell.*

A glabrous annual, with erect or ascending often angled stems, 18–30″ high, and linear obtuse leaves, ·7–3″ long, minutely saw-edged, with petiole ·1″. Flowers most minute in short terminal or leaf-opposed spikes, ·25–·5″ long, female at the base and male above, or female also solitary. Female perianth with ovate segments, persistent and enlarged in fruit, fimbriate and ciliate. Capsule ·17″ long, 3-lobed, lobes each with two lines of short spines.

Cultivated ground. Ranchi, *Clarke*, *Wood*! Hazaribagh! Singbhum! Manbhum, *Kurz*! Behar, *Kurz*! Fls., Fr. Oct.–Dec.

22. BRIDELIA, *Willd.*

Trees or shrubs, sometimes scandent, with entire, rarely somewhat crenate leaves with strong parallel secondary nerves frequently uniting in a marginal nerve, and small monœcious, rarely diœcious flowers in axillary clusters, or clusters in simple or panicled spikes. Calyx with 5 sometimes sub-perigynous, valvate, persistent sepals, and 5 usually small, white, persistent petals inserted under the margin of the prominent disc. Disc flat or somewhat concave, often with an annular rim in the male, in the female furnished with a corona (or inner disc of some writers) from the inner margin, which often closely invests the ovary and is toothed or lobed, or consists of sub-petaloid lobes. Stamens 5, on a distinct gonophore with a pistillode. Ovary 2-celled, with 2 free or partially connate styles, often 2-lobed. Fruit a drupe, with a 2-celled stone, ultimately splitting into 2 1-seeded, 2-valved (always ?) pyrenes.

I. Erect trees or shrubs with secondary nerves unbranched up to the marginal nerve.
  A. L. mostly over 4″ long, oblong or obovate.
    Secondary nerves 15–20. Fls. axillary and spicate glabrous. Fr. globose . . . . 1. *retusa.*
    Secondary nerve 8–16. Fls. all sessile axillary, pubescent at base. Fr. oblong . . . . 2. *verrucosa.*
  B. L. mostly under 4″, lanceolate.
    Secondary nerves 7–13. Fls. glabrous. Fr. globose . . 3. *tomentosa.*
II. Erect. Secondary nerves forked, looped or reticulate within margin (exc. 4 var. *Hamiltoniana*).
    Shrub with rhomboid obovate L. Sepals glabrous . . 4. *montana.*
    Tree with oblong acuminate L. Sepals pubescent . . 5. *pubescens.*
III. Sarmentose or scandent, nervation as in I. Sepals pubescent 6. *stipularis.*

1. **B. retusa,** *Spreng.* Syn. B. spinosa, *Roxb.*; Cluytia retusa, *L.*; Karaka, *M.*; Kaka, *Ho.*; Kadrupala, *S.*; Kaj, *Kharw.*; Khooj, *Th.*; Kasai, Kosai, *Beng., Or.*; Pani-kasi, *Or.*

A small or moderate-sized tree, usually with long conical thorns on the trunk when young, stiff, elliptic-oblong, acute or obtuse, rarely rounded leaves, with rounded base and 15–20 strong secondary nerves which meet a marginal one. Flowers small, greenish, in axillary clusters and clusters also in long spikes, 3–6″ long, males and females usually intermixed. Fruit greenish-yellow or flesh-coloured, globose, ·25–·3″ diam., pyrenes ridged.

Throughout the province, in the dryer districts usually near streams and nalas, or on the cool sides of the hills. Fls. Aug.-Oct. Fr. Nov.-Jan. Evergreen.

Attains 4–5 ft. girth with grey flaky bark, rather thick and a dark crimson blaze. L. 4–10″ long, mostly about 6″, usually pubescent, grey or glaucous beneath, sometimes somewhat obovate, base sometimes subcordate, never acute, except on occasional branches, tertiary nerves closely scalariform. Petiole ·25–·5″, often swollen. Male fls. pedicelled, female sub-sessile, sepals lanceolate, petals of male broad, angular, or coarsely toothed, of female oblong, entire persistent. Disc of male thick, patelliform, scarcely lobed, of female annular with an inner sub-petaloid limb, entire or of 5 lobes, erect in the young fl., ultimately spreading.

The drupes are quoted as purplish-black by Brandis, and in the *F.B.I.* This is so when over-ripe or dry, but they are usually eaten before that stage by green-pigeon, hornbills and parrots, of which birds they are a favourite food.

The heart-wood is deep brown, veined black, and is very handsome. *Gamble* states that it is durable, and that the weight is about 52 lb. The poles are largely used in native houses and for agricultural implements. The leaves are much cut for buffalo fodder.

The seedling has broadly emarginate, faintly nerved cotyledons; the first leaves are strongly nerved.

2. **B. verrucosa,** *Haines.* Syn. B. montana, *Hook. f.* (in *F.B.I.*), non *Willd.*; vide *Journal of Botany*, 1921.

A small tree without much trunk, which is short and sometimes thick, but never thorny, closely branched, with upright verrucose branches. Leaves broadly elliptic or obovate, with rounded tip, 3–6″ long on the flowering branches, often 8″ on flowerless ones, with 10–16 strong secondary nerves, meeting a marginal one as in *retusa*, beneath pallid, glabrous or nearly so, base rounded. Flowers never spicate, in dense axillary clusters on small tubercles in the axils of standing or fallen leaves on previous year's branchlets, closely invested by the broad, scarious, thinly hairy bracts, which are as long as the male flowers, monœcious, sessile, males with a small villous sheath at the base, females also villous on the tube. Fruit broadly ellipsoid.

Sameswhar Hills, near nalas! Common in rocky ravines in the Santal Parganas Ravines in the higher hills of Chota Nagpur! Parasnath, *J.D.H.*, *Clarke*, *Campbell*! Fls. Oct.-Dec. Fr. Feb.

Bark flaky in old trees, blaze red or crimson as in *B. retusa.*

Branchlets brown, glabrous, except on new shoots and buds, pustulate. Male fl. shorter than the female, with obovate, irregularly lobed or toothed petals inserted outside the patelliform, crenulate and rugose disc. The curious villous sheath is detachable from the fl. on boiling, and I am unable to state its morphological significance; it is perhaps the pedicel. Female fl. ·06–·07″ long, with lanceolate acuminate sepals and oblanceolate entire petals. Disc conical, with small mouth girting the base of the long styles and usually circumsciss at the base, becoming lifted up as a cap on the young fr., but variable.

3. **B. tomentosa,** *Bl.* Syn. B. lanceæfolia, *Roxb.*

A large bushy shrub or small tree with often drooping branches, slender, rusty tomentose or pubescent, or (in age) puberulous twigs, and small lanceolate, or linear-lanceolate, or sometimes oblanceolate, often acuminate leaves, 1–4″ long, pale or glaucous and more or less pubescent or puberulous beneath, with 7–13 nearly straight secondary nerves running without branching or reticulating into a marginal nerve; tertiary nerves close scalariform. Flowers glabrous, monœcious or diœcious, very small, clustered, axillary, or rarely ends of the branchlets without leaves, white, ·15–·17″ diam. Fruit ·17–·25″ diam., blue-black.

Usually in the damper region. Purneah! Gya, *Ham., And.*! Eastern Manbhum! Santal Parganas! Dhalbhum, *Gamble*! Puri, frequent. Fls. Sept.-Oct. Fr. Nov.-Jan.

Attains tree dimensions in Purneah with smooth white bark and red blaze. L. sometimes attain 6″ on the main branches, but are smaller upwards, and often only 1″ on the flowering branches, dull above, base acute or obtuse, or rounded on the ·1″-long pubescent petiole. Sepals ovate to lanceolate, petals half as long, obovate or rounded with broad claw, coarsely toothed in both sexes or entire in the female.

In old drupes the pericarp splits into 6 valves and each of the pyrenes into 2 valves. Seed black, somewhat cordate.

Cotyledons epigeal, broad and somewhat emarginate, seedling pubescent, first pair of leaves opposite or alternate, stipules setaceous.

4. **B. montana,** *Willd.* non *Hook. f.* (*F.B.I.*). Syn. Cluytia montana, *Roxb.*; B. Hamiltoniana, *Wall.*; vide *Journal of Botany*, 1921; Marda, *Or.*

A much-branched, large shrub, with usually numerous stems or long brown branches, glabrous or nearly so; leaves 2–4″, mostly rhombic-obovate, varying to rhombic-ovate, sub-orbicular, or occasionally oblanceolate or lanceolate, with 6–7 (very rarely up to 10 and then only in a few leaves) secondary nerves, with the ends mostly forked, looped, or reticulate before reaching the margin, glabrous or sometimes puberulous beneath. Stipules persistent (for the genus), narrowly linear-lanceolate, ·2″ long, often curved. Flowers usually few in an axil with lanceolate, almost glabrous bracts, sessile, quite glabrous, ·08–·1″ long, monœcious. Male petal broad, strongly angled or toothed; female rhomboid or obovate, minutely toothed. Lobes of pistillode subulate. Fruit 25–·3 diam., ultimately much like that of *tomentosa*.

Usually in dry rocky places, or in the dryer parts of the province in rocky nalas, not common. Monghyr Hills, *Ham.*! Kurz! Behar, *J.D.H.*! Sambalpur, especially in the Boropahar range, frequent! Fls. Aug.-Sept. Fr. Oct.-Dec.

Bark thin, rather rough on old stems, blaze pink. Branchlets not pustulate. Petioles ·1–·2″, glabrous or pubescent. L. margins sometimes repand or shallowly crenate. Inner disc in female fl. broadly cupular, scarcely covering half the subglobose ovary or longer, minutely toothed or 4–5-lobed in flower, 4-5-fid to base in fr.

Var. **Hamiltoniana,** *Wall.* (sp.)

Pubescent. L. with several of the secondary nerves running into the marginal nerve. Monghyr, *Ham.*! Kaimor Hills, *J.D.H.* (but glabrous)!

5. **B. pubescens,** *Kurz.*

A small tree with pubescent or tomentose twigs, narrowly elliptic leaves, acuminate at the apex and pilose or thinly hairy beneath,

with rounded or acute base and 7–15 secondary nerves, mostly looping within the margin. Flowers white, ·2–·25″ diam., densely pubescent outside in axillary dense clusters and sometimes short spikes. Drupe ellipsoid or oblong, ·5″ by ·25″.

Along streams. Saranda forests, Singbhum, usually above 2000 ft.! Similipahar forests, Mayurbhanj, above 3000 ft.! Fls. April. Fr. ripens the following c.s. Evergreen.

L. 4–10″ long, rarely some of the lower on a twig broadly elliptic, base sometimes oblique and cuneate, texture thinner than in *retusa* and *montana*. Male fls. with short stout pedicels, female subsessile. Sepals lanceolate. Petals broadly flabellate or rhomboid in male and tip sometimes 3-toothed; oblong or obovate entire in female, outside pubescent. Male disc often granulate with smooth annular margin, female like the male but smoother and thinner, and with inner tubular conical limb nearly concealing the ovary obscurely lobed.

6. **B. stipularis,** *Bl.* Babu janga, *S.*; Kunji, *Th.*; Nota Kasi, *Or.*

A large woody climber with pendent branches, broadly elliptic-oblong, strongly-nerved leaves mostly about 4·5 by 3·5″, but much reduced on the flowering branches, and those on the lower branches sometimes (as in the case of most *Bridelias*) exceptionally large and up to 8″, hairy or sub-tomentose beneath. Flowers monœcious, numerous, axillary, or spiked, and in panicled spikes, green, densely hairy outside. Drupes oblong, red (till over-ripe), ·5″ long.

In the moister regions only. Northern tract, all along the northern boundary and throughout Purneah! Santal Parganas, along the banks of nalas and in ravines! Mayurbhanj, at higher elevations! Puri! Baud, Daspalla, and Nayagarh in Orissa, *Cooper*. Fls. May–Oct. Fr. Dec.–Feb. Evergreen.

Branches pubescent. L. obtuse or rounded, or suddenly acute at the tip and with rounded or sub-cordate base; secondary nerves 7–12, strong, joining a marginal nerve with strong scalariform tertiaries and nervules. Fls. ·15″ long, fruiting calyx ·3–·4″ diam. Petals obovate or orbicular, sometimes with a dorsal tuft of hair, alike in both sexes (teste *F.B.I.*) or (in my specimens) toothed in the male only. Female disc densely hirsute at base within.

The fr. is globose in a Purneah specimen, and the sepals densely shaggy with fulvous hairs outside.

23. CLEISTANTHUS, *Hook. f.*

Trees or shrubs, with bifarious entire leaves and small diœcious or monœcious flowers in axillary clusters, clusters sometimes also spicate. Calyx 4–6-sepalous, valvate, petals, stamens and disc much as in *Bridelia*. Ovary 3-celled, usually with long hairs, styles 3, 2-fid, ovules 2 in each cell. Fruit capsular, 6-valved, or of three 2-valved cocci. Seeds without aril or caruncle. Cotyledons thin or fleshy, often folded.

L. broadly elliptic. Ovary glabrous . . . . 1. *collinus.*
L. ovate to lanceolate. Ovary pilose. . . . . 2. *patulus.*

1. **C. collinus,** *Benth.* Syn. Cluytia collina, *Roxb.*; Lebidieropsis orbicularis, *Muell. Arg.*; Parasu, *M.*; Pasu, *Ho.*; Kargali, *S.*, *Kharw.*; Karla, *H.*; Garari, *Gond.*; Korora, Karada, *Or.*

A small, rarely moderate-sized tree, with orbicular, obovate or elliptic leaves, 1–4″ long by ·75–3″ broad, glaucous beneath and small green flowers, ·25–·3″ diam., appearing with the new leaves, the males clustered, the females often solitary sessile. Capsules somewhat 3-gonous, woody, chestnut-coloured when ripe, shining, ·75–1″

diam., sometimes dehiscing with a considerable report on hot evenings.

Central and Southern tracts: Shahabad! Gaya! Chota Nagpur, very common on the hills, but local; a large form occurs along nalas! Santal Parganas, south of the Brahmini! One of the commonest trees throughout Orissa and Sambalpur! Fls. April-May, occasionally also in Sept. Fr. ripens March-April of the following year. Deciduous March-April.

Bark nearly black, rough, with red blaze. Twigs slender, lenticillate. L. rounded or retuse, both ends with fine reticulate nerves, sometimes slightly silky beneath when young. Petiole ·17-·25″. Stipules deciduous, hairy, shorter than petiole. The fls. are often diœcious, males in few-flowered clusters, females solitary, buds conical, 5-angular, softly pubescent, with minute villous bracts; sepals spreading, often twisted, sometimes ·25″ in female; petals minute, fleshy, sometimes 0. Disc of male, pulvinate, of female conical, with a thick margin and partly surrounding the glabrous ovoid ovary.

The wood is durable, and is prized for house posts, fences, etc., as it is not attacked by white ants. All parts of the tree are very astringent, and the roots and fr. are poisonous and used to poison fish. Campbell says that the bark is applied in cutaneous diseases. The tree coppices freely, and as it is not eaten by goats it sometimes forms the only vegetation on rocky hills exposed to browsing and is of the greatest assistance in re-afforestation. Makins states that a 5-year-old coppice in Singbhum showed growth of 10 ft. high and 5″ girth.

2. **C. patulus,** *Muell.* Sanahati, Sarpatria, *Or.*

A small tree with close branches and slender glabrescent twigs. Leaves ovate to elliptic-lanceolate and acuminate with rounded base, 2·5-4″, rarely 5·5″ long, quite glabrous but pallid beneath, with 5-8 slender secondary nerves, looping or reticulate some distance from the marginal nerve, on flowering branches often reduced and nearly white. Petiole ·2″. Flowers green with white disc and anthers, monœcious or sub-diœcious, 2-3 in a fascicle only; fascicles spicate on new short leafless branches, or in the axils of white bractiform leaves; sepals 4-6, oblong, acute, glabrous, ·15″ long in female, shorter in male; petals obovate, clawed, crenulate in male, sub-entire in female, disc shortly cylindric, thin, shallowly crenate, or minutely toothed in male, sometimes deeply lobed in the female, not as long as the globose densely villous ovary; pistillode large and 3-lobed. Capsule ·35″ diam., deeply 3-lobed, somewhat silky in the furrows.

Southern tract only. Puri, rocky hill-sides 2000 ft.! Mayurbhanj, 2000 ft. and above! Angul, in rocky ravines! Fls. Feb.-April, also found in fl. in July. Fr. April-May.

Bark smooth, exfoliating in thin plates, brown underneath, blaze pink or crimson, then yellowish.

Gamble says that the wood is reddish-brown, hard and close-grained. Weight about 50 lb.

24. FLUEGGEA, *Willd.*

Shrubs, sometimes thorny, with small distichous leaves, and minute, pedicelled, axillary diœcious flowers, clustered in the leaf axils, or females sub-solitary. Sepals 5, imbricate, sub-petaloid. Male flowers, stamens 5, free, alternating with 5 fleshy disc-lobes or glands, pistillode small, with 2-3 long styles. Female flowers with annular toothed disc, ovary 3-celled (1-3, *F.B.I.*), with long recurved styles connate at the base, entire or 2-lobed above; ovules 2 in each cell. Fruit globose, dry or with white fleshy epicarp, finally loculicidally dehiscent. Seeds not arilled, triquetrous, dorsally convex.

1. **F. obovata,** *Baill.* Syn. F. microcarpa, *Bl.* Securinega obovata, *Muell.*; Xylophylla obovata, *Willd.*; F. virosa, *Baill.*; Sikat, *Kharw.*; Remre-horte, *S.*; Patri, *Or.*; Bari Pitondi, *Vern.*

A glabrous, usually straggling shrub, with thin elliptic, obovate, or orbicular thin leaves, mostly 1–3″ long, sometimes attaining 4·6 by 2″, glaucous beneath. Flowers pedicelled, clustered in both sexes on filiform ·17–·5″-long pedicels. Fruits pretty, white, ·3″ diam., rarely dry and only ·12–·17″ diam.

Champaran! Gaya! Santal Parganas! Singbhum, in valley forests, frequent! Manbhum! Ranchi! Hazaribagh! Palamau! Puri, chiefly in the Mals! Sambalpur! Probably therefore in all districts. Fls. May–Aug. Fr. July–Sept. Evergreen, or nearly so, new leaves in May.

Bark thin, nearly smooth, blaze pink. Rarely somewhat climbing or thorny. Branchlets angled or compressed. L. with usually rounded apex, base cuneate, secondary nerves slender and scarcely raised at time of flowering, in mature L. raised and prominent, 5–8, tertiaries rather irregularly scalariform, finely reticulate between. Petiole ·12–·25″ slender. Fls. about ·08″ diam. only, sepals thin, rounded.

25. AGYNEIA, *Vent.*

Herbs, or suffruticose with diffuse often angled or compressed stems and small entire leaves. Flowers minute, monœcious, pedicelled, axillary; males clustered; females larger, sub-solitary. Male sepals 6, gland-dotted with thin white margins, disc 6-lobed, stamens 3 with connate filaments, and sub-sessile anthers with longitudinal dehiscence. Female flowers with much larger sepals, sometimes not margined, disc 0, ovary turbinate, with expanded top and slightly depressed centre, with short, 2-fid, thick, spreading styles. Ovules 2 in each cell. Fruit not lobed, splitting into three 2-valved cocci. Seeds slender, curved, hilum long. Embryo curved, with broad flat cotyledons.

1. **A. bacciformis,** *A. Juss.*

Stems 6–18″, spreading, laxly branched, angular, with somewhat woody base. Leaves elliptic to oblong-obovate, ·25–·5″, rarely ·75″ (in our area), acute or obtuse, apiculate, rather thick, sub-sessile; secondary nerves not evident. Stipules lanceolate or deltoid and auricled, setaceous, bracts subulate setaceous. Male flowers under ·05″ diam., 2–4-nate, with slender pedicels from the lower axils. Female flowers 1–2 near the top of the branches, ·15″ diam., with ovate long-acuminate sepals. Capsule very distinct, drooping, oblong-ovoid with truncate tip, ·22″ long.

Chandpur, Balasore, near the sea! Fls., Fr. May.

26. PHYLLANTHUS, *L.*

Shrubs or herbs with slender branches, often supported by bracts, and bearing small, alternate, distichous leaves, which with the branchlet resemble pinnate leaves and are sometimes deciduous with it, stipulate. Flowers small or minute, monœcious, in axillary clusters or sub-solitary, apetalous; females with usually accrescent perianth and larger than the males. Sepals 5–6, imbricate in two series. Disc in male of minute glands; of female of glands or

expanded and often lobed. Stamens 3, with filaments united into a short column, anthers oblong or didymous, sometimes connivent or spreading, but never connate, 2-celled, cells linear or oblong with vertical dehiscence or subglobose, and often confluent with vertical or transverse dehiscence, connective produced or not. Ovary 3-celled. Styles 3, free or connate at base, often flattened, 2-fid or 2-lobed. Fruit of three 2-valved cocci, rarely with a sub-succulent epicarp. Seeds 3-gonous, with rounded back, strophiolate.

NOTE.—*Phyllanthus* is here limited to the sections Paraphyllanthus and Euphyllanthus of Mueller (in *DC. Prodromus*) and the *F.B.I.*

I. Anthers with vertical dehiscence, usually oblong.
  A. Shrub. L. linear-oblong. Anthers apiculate . . 1. *Lawii.*
  B. Herbs.
    1. Anthers with connective apiculate or muticous.
      L. cuneate-obovate. Capsule smooth . . . . 2. *maderaspatensis.*
      L. oblong to linear-oblong. Capsule verrucose . . 3. *urinaria.*
      L. oblong to linear-oblong. Capsule sub-succulent . var. *laevis.*
    2. Anthers very short, connective, with crescentic crest 4. *simplex.*
II. Anthers with transverse dehiscence (exc. perhaps in 8).
  A. Erect herbs, sometimes suffruticose below.
      L. elliptic oblong. Female fl. ·06″ diam. in fr. . . 5. *niruri.*
      L. elliptic, ·5–·75″. Male and female fls. ·1″ diam. . 6. *debilis.*
  B. Small prostrate herbs with very small leaves.
      L. ·1–·2″. Fls. ·1–·2″ diam. . . . . . . 7. *rotundifolius.*
      L. ·1–·15″. Fls. under ·05″ diam. . . . . . 8. *nanus.*

1. **P. Lawii,** *Grah.* Tirsibirsi, *M.*; Jhawar-khandera, *S.*

A pretty shrub with numerous erect rigid stems, 3–4·5 ft. high, densely clothed with spreading leafy branchlets with very close often raised nodes and persistent stipules. Leaves distichous, crowded, sub-sessile, ·1–·3″ long, linear-oblong, obtuse, glaucous, with sub-cordate base and 3–4 faint secondary nerves. Flowers minute, pink, solitary or few in nearly all the axils. Fruit nearly dry ·12–·17″ diam., smooth.

Gregarious along the banks and in the beds of rocky rivers with a constant water supply. Throughout the area, but local! Fls., Fr. Jan.–March.

Branches terete, glabrous. Stipules narrowly subulate, 3–4 times the minute petiole. Pedicels ·06–·12″ long. Male fl. sepals ·05–·1″ long, outer oblong, inner rather smaller, oblong or obovate-oblong. Disc of 6 peltate glands. Anthers slightly apiculate, erect, linear-oblong; combined filaments at first very short, finally as long as the anthers. Female sepals ·06–·1″ long, oblong-obovate. Ovary 3-lobed and lobes again slightly channelled. Styles flattened, sub-erect, connate only at base, with two spreading lobes. Seeds smooth, microscopically pitted, reddish.

2. **P. maderaspatensis,** *L.*

Erect, herbaceous or suffruticose, 12–16″ high, with ascending, glabrous, angled branches, and usually cuneate-obovate leaves, ·25–·8″, rarely 1″, glabrous with rounded and apiculate apex. Stipules large, persistent, ·08″, lanceolate, acuminate, scarious, basifixed or peltate (*F.B.I.*). Flowers numerous on the under side of the branchlets, males usually fascicled with one much larger female ·1–·15″ diam. in fruit and with a pedicel about ·06″ long. Capsule smooth, depressed, globose, ·1–·12 diam., shallowly 6-lobed.

Not common. Behar, *Kurz*! Balugaon, Puri, *Hooper*! Fls., Fr., Feb., March, Aug. and Sept.

Sometimes decumbent below. L. sometimes truncate or retuse, usually rounded at apex; secondary nerves 4–6, oblique, not looping. Male fls. ·05″ diam. with

rounded or obcuneate sepals. Disc of glands in both sexes. Anthers free above with longitudinal dehiscence. Female sepals obovate, or inner oblong-obovate green with white margins, sometimes keeled within. Styles free, minutely 2-lobed. Seeds striated in lines of dots.

3. **P. urinaria,** *L.*

A suffruticose annual, with slender erect stems, 6–18″ high, somewhat compressed or angular, with numerous spreading leafy branchlets resembling pinnate leaves, 1·5–3″ long, with ovate setaceously-acuminate stipules at their base, ·12″–·15″ long. Leaves small, distichous, upper imbricate, ·12–·4″ long only on some plants, up to ·6″ on others. Flowers minute, reddish, axillary, but secund and appearing to be borne in a continuous row on the under surface of the branchlets; both sexes sessile or sub-sessile, the larger female under ·1″ diam. Capsule depressed, globose, usually minutely, densely verrucose, seeds with marked tranverse furrows on the back and faces.

Very common and probably in all districts, in the rains. Fls., Fr. July–Dec. Annual.

Stems often reddish. L. oblong or linear-oblong, apiculate, base unequal, margin minutely ciliolate, beneath glaucous, with 4–5 fine secondary nerves looping within the margin, one usually near base, subsessile, stipules subulate or filiform, ·05–·07″. Clusters of fls. functionally 1-sexual, the males first developing and deciduous, and subsequently the females, so that the lower ones appear all female. Male ·04–·05″ diam., sepals oblong, white, often with red centre, ciliate in the type; stamens 3; anthers erect, connivent, not connate, broader than long, but dehiscence longitudinal; filaments very short, connate (in our specimens, free, *F.B.I.*), disc glands 6, most minute, peltate. Female fls. ·07″ diam., sepals linear-oblong, spreading, with red centre, stigmas (styles?) broad spreading, connate at base, with 2 minute spreading lobes.

Var. **lævis,** *Haines.*

This appears to differ from the type in the basifixed stipules, the quite glabrous sepals, connate filaments (very short, and I doubt the type being free as described). The fr. is quite smooth and sub-succulent when fresh! Swampy places, Neterhat, 3500 ft.!

The leaves exhibit sleep movements like the leaflets of a true pinnate leaf.

4. **P. simplex,** *Retz.*

A herb with numerous slender branches from a somewhat woody stock; stems 1–2 ft. high, terete, with a keel on one or both sides decurrent from the leaf bases, or distinctly compressed, glabrous, with very long slender branches and more or less secund or distichous linear-oblong leaves, ·3–1·3″ long, subsessile, with secondary nerve scarcely visible beneath. Flowers minute from an axillary cluster of minute bracts, about 2, very shortly pedicelled, minute males, and usually one long-pedicelled female from each cluster. Female pedicel in fruit ·2–·3″ long, clavate above. Capsule depressed, globose, ·12″ diam., smooth and glabrous, or sometimes slightly pubescent or minutely worted.

Common, probably in all districts. Monghyr Hills, *Kurz*! Singbhum, very common in open places and low jungle in the rainy season! Manbhum, common! Orissa, *Hooper*! Fls., Fr. Aug.–Dec. It is not usually seen much after Dec. and is, I think, annual in our area.

L. narrowly elliptic-oblong in Monghyr specimens; often distichously imbricate when young, rather thick with prominent midrib, and about 5 slender looping

secondary nerves visible above, beneath glaucous, base rounded or sub-cordate, apex acute or obtuse and mucronulate. Stipules very small, triangular, often with an auricled base on one side (described as peltate in *F.B.I.*, but rarely so). Male fl. about ·03" diam., column subsessile, with connectives terminating in three curved ridges above the broadly oblong 2-celled anthers which dehisce longitudinally. Disc of broad lobes (glands?). Female fl. ·06–·07" diam., sepals ovate-oblong, larger in fr., disc annular wavy, ovary minutely mammillate, styles spreading flat on the top of the ovary, grooved, with 2 recurved stigmas. Seeds with lines of most minute worts, or practically smooth.

5. **P. niruri,** *L.* Jar-amla, *H.*; Bhuiamla, *Beng.*

An erect, very slender glabrous annual, about 1 ft. high, with very numerous spreading or erecto-patent slender branches, 4–6" long, looking like pinnate leaves. Leaves elliptic-oblong, more rarely somewhat obovate or linear-oblong, distichously spreading, ·15–·75 long. Flowers minute, green or whitish, about 2–3 male and one female in an axil, males on pedicels ·03–·04" long only, sepals ·03". Female flowers much smaller than in *P. debilis*, with calyx about ·06" diam. in fruit, with oblong sepals. Fruits small, globose, forming a row on the under side of the branchlet, glabrous, ·08–·12" diam., on pedicels ·2–·3" long. Seeds each a one-sixth segment of a sphere, brown with vertical lines (of minute dots) and transverse slender striæ.

A common weed, probably in all districts. Fls., Fr. r.s.

Branches angled, usually 2-edged. L. sensitive, base obtuse, apex obtuse or acute, secondary nerves 2–4, obscure. Petiole hardly any, stipules ovate, acuminate, or subulate. Male: sepals orbicular, anther-cells 3, on top of short column, most minute, with transverse dehiscence; disc glands 6, very minute. Disc of female patelliform lobed. Styles minute, free, 2-lobed. Capsule sometimes minutely granulate.

The plant is considered de-obstruent, diuretic, astringent and cooling, and is administered in jaundice, dropsy and genito-urinary affections. A bitter principle called Phyllanthin has been isolated from it. (*Nadkarni.*)

6. **P. debilis,** *Ham.*

An erect slender herb or undershrub, 1–3 ft. high, with straight single stem and many erecto-patent or spreading branches, which are 2–4-edged and frequently microscopically toothed on the angles. Leaves distichous, elliptic or elliptic-obovate, ·5–·75" long, obtuse or rounded at apex, glabrous. Stipules narrow-lanceolate, with setaceous tip, often twice the very short petiole. Flowers all shortly pedicelled in small bracteate axillary clusters, or sometimes on distinct peduncles, densely clothed with imbricating, linear-acuminate, white nerveless bracts, and often ·1" long. Male campanulate, about ·1" diam. (when opened out), sepals 6, subequal, oblong or outer larger elliptic-oblong; disc glands 6, filaments combined into a *distinct column* (free, *F.B.I.*!), with very short, free portion above and broadly-oblong anthers, with transverse dehiscence. Female flower on a clavate pedicel longer than that of the male, and sometimes attaining ·1" in fruit; sepals spreading, green with white margins, oblong-spathulate or obovate-oblong, ·08–·1" long. Capsule smooth, slightly over ·1" diam.; seeds pale, with numerous curved parallel lines of microscopic raised red dots.

Chiefly in shady places, common in the forests. Probably in all districts.

Purneah! Monghyr, *Kurz*! Rajmahal Hills, *Kurz*! Gaya! Palamau, ascending to 3000 ft., common! and throughout Chota Nagpur, ascending to top of Parasnath! Often perennial with deciduous branchlets and leaves. Fls., Fr. May.-Jan.

Stems often woody, terete with raised lines below. L. with rounded or cuneate base, lower surface pale, microscopically papillose, with 4-5 slender, very fine secondary nerves, margin thickened.

7. **P. rotundifolius,** *Klein.*

A pretty little plant with prostrate and ascending numerous stems 8-18″ long, and small round leaves ·1-·2″ diam. only, pinnately arranged on numerous lateral branchlets 1-1·5″ long. Petiole distinct, one-fifth as long as the leaf. Male flowers ·1″ diam. (when opened out), often on short bracteate peduncles as in *debilis*. Structure of the flowers exactly as in *debilis*, from which it is very easily distinguished by the leaves and habit as well as the short pedicels (under ·1″ in fruit).

Sea coast, on the sands, Puri! Fls., Fr. Sept. Perennial.

Rootstock rather woody. L. apiculate, glabrous or minutely pubescent beneath, margin thickened, secondary nerves obscure. Female fls. ·2″ diam., sepals ovate or ovate oblong, white with green mid-rib, disc annular and gland-papillose as in *debilis*. Disc of male of minute green glands or glands larger and papillose. Capsule pale. Seeds pale brown, smooth, with fine curved raised lines.

8. **P. nanus,** *Hook f.*

Resembles a very dwarf *P. niruri*, with spreading branches or stems, 3-6″ long only, and very small oblong leaves ·1-·15″ long. Female flowers with oblong obtuse or suddenly acute sepals.

Hooker says "this resembles a minute, rigid, branched *Niruri* and has similar styles, but is smaller in all its parts with differently ribbed seeds." A drawing on the sheet shows, however, the short didymous anthers with vertical dehiscence. The seeds are longitudinally striate with short transverse striæ.

The species is added to our Flora on a note by Col. Gage in *Herb. Kew* that "this (a Burman specimen of *P. nanus*) agrees with the specimen of *Phyllanthus sanphalia*, Ham., No. 2093, in *Herb. Ham.* at Edinburgh, and collected at Monghyr.

27. PROSORUS, *Dalz.* (*Phyllanthus*, sec.)

Diœcious small trees with deciduous branchlets and leaves more or less pinnately arranged. Flowers small in clusters, mostly below the leaves, in the axils of caducous bracts on the new shoots, sepals in two unequal pairs. Disc of male large, flattened, faintly lobed, sometimes narrower in the female. Filaments 4, opposite the sepals from inside the disc, with oblong anthers and longitudinal dehiscence. Styles 3, stout spreading 2-fid. Fruit with thin dry epicarp, bursting irregularly, and enclosing 3 thin-walled 2-valved cocci. Seeds usually blue. The genus was included in the section Cicca of *Phyllanthus* by *Muell. Arg.*, but the 3-locular ovary and dry fruit is rather that of *Phyllanthus* proper.

1. **P. indicus,** *Dalz.* Syn. Phyllanthus indicus, *Muell Arg.*

A small straight tree, with white bark, glabrous, with broadly elliptic obovate, or elliptic-oblong obtuse, or sometimes shortly acuminate leaves, at the time of flowering very membranous and only 1-3″ long, finally 2-6″ long. Male flowers very small, green, on

slender ·2–·25″-long pedicels, in dense clusters, mostly below the leaves on the new shoots. Females in similar positions but fewer, ·1–·15″ diam. Fruit ·4″ diam., depressed globose.

Mals of Orissa, on the higher hills, not common! Fls. April-May on the new shoots. Deciduous Feb.-March.

Blaze white with chlorophyll (but I have only seen small trees in our area). Branches covered with white lenticels. L. glaucous when mature, with 5–7 fine secondary nerves, soon reticulate. Petiole ·25″. Stipules oblong-lanceolate, acute, ·1″, base sometimes sub-hastate. Sepals green, membranous, oblong or obovate-oblong, reflexed. Female pedicels often ·5″ long and stouter.

28. EMBLICA, *Gärtn.*

Trees with small leaves pinnately arranged on short lateral branchlets, which are supported by a small bract and two stipules, and are often deciduous. Juice somewhat milky. Stipules minute, scarious. Flowers minute, axillary, and from axils of scales below the leaves, secund towards the lower surface. Female flowers chiefly in the lower axils, but mixed with the males, and with shorter pedicels. Sepals 6 (–5). Filaments connate into a slender column, anthers 3, free, but broad connectives connivent back to back, cells with vertical dehiscence. Disc 0, or of distinct glands in male, cupular in female. Ovary 3-celled, styles more or less connate below, 2–3-fid or twice 2-fid above. Ovules 2, collateral in each cell. Fruit a drupe with woody, 3-celled, 6-grooved endocarp.

1. **E. officinalis,** *Gärtn.* Syn. Phyllanthus emblica, *L.*; Cicca Emblica, *Kurz*; Amla, Aonla, Amlika, *H.*, *Beng*; Aura, *Or.*; Miral, *K.*; The Emblic Myrabolan.

A small or moderate-sized tree, with greenish-grey or red bark, peeling off in scales and long strips and with pretty feathery grey foliage. Branchlets hairy, 3–8″ long, with close-set, distichous, linear, glabrous, margined leaves, ·3–·75″ long, imbricate when young. Stipules fimbriate, or with a hair tip. Flowers densely fascicled, yellowish on the new shoots, males on slender pedicels, females subsessile, few. Fruit globose, succulent, yellow or pink when ripe, ·7–1″ diam., with a 6-ridged putamen (not of cocci) which is tardily dehiscent at the ridges.

Common throughout the area and in all situations. Fls. Feb.-May. Fr. Oct.-April (often ripe in Oct.). Deciduous March-April.

Bark of young trees quite smooth, greyish-white, blaze pink, in old trees hard and dark crimson.

Wood fairly good and much used for native houses, also for agricultural implements. The fruit contains much gallic acid and is astringent but sialagogue, and hence is often taken by Indians in the forest when thirsty. *Mr. Fraymouth* says that as a tannin material he had nothing good to say of either fruit or leaves though they contain a high percentage of tannin, but that the twig-bark has proven of great value as a light tan-stuff, and might take the place of a third of the Tarwad now used (1917). The fr., fresh and dried, is largely used in Hindu medicine, different preparations being diuretic and laxative or useful in diarrhœa and dysentery and in dyspepsia. It is eaten as a cure for cough in Chota Nagpur, and the juice of the fresh fr. as well as an infusion of the seeds for inflammation of the eyes. Campbell says that, boiled till it becomes of an oily consistency, it is used for Khasra (a skin disease). The frs. boiled with sugar make an excellent preserve.

The growth of trees which were raised from seed at Chaibassa was 37 ft. in height and 26·5″ girth in 16 years. It coppices easily, but requires to be cut low down or the shoots are produced above the ground.

29. CICCA, *L.*

Characters of *Emblica*, but leaves larger and flowers usually 4-merous. Filaments free. Clusters of flowers usually racemed from the reduction of leaves on the branchlets, clusters with several males and 1-2 females. Ovary 3-4-celled and -lobed with 3-4 spreading 2-fid stigmas. Drupe usually 3-4-lobed with 3-4-angled putamen.

1. **C. disticha,** *L.* Hariphal, *Beng.*; Nuree, Nurphal, *H.*; Aura-kuli, Bungarada, *Or.* Star Gooseberry.

A small or moderate-sized tree with very thick branches closely marked with the scars of the deciduous branchlets, and often tuberculate, bearing a terminal cluster of what look like pinnate leaves, 6–15″ long, with a number of small bracts at their base, and subtended by a bract and its two stipules. Leaves (the apparent leaflets) 1–2·5″ long, at base of the rhachis shorter and roundish, the upper larger ovate-lanceolate acute, somewhat pale glaucous beneath. Stipules minute, subulate. Flowers mostly in slender racemes from the tubercles, rarely 2-sexual, males red, minute, sepals 4, imbricate in pairs, stamens 4. Females green, larger, sepals 4, two usually larger than the others, ovary shortly stipitate with 3–4 spreading 2-fid styles. Fruit much depressed, globose, and 6–8-grooved, about ·7″ diam.

Frequent in gardens. Fls. May. Fr. June–July.
The green leaves are eaten as a sag and the acid fruits are eaten cooked and as a preserve.

30. KIRGANELIA, *Baill.*

Slender shrubs, usually sarmentose, or sometimes climbing by means of hardened reflexed stipules and bract at the base of the shoots, branchlets often deciduous. Leaves small or moderate-sized, pinnately arranged on the slender branchlets, stipules lanceolate entire, basifixed. Male and female flowers mixed in axillary, few-flowered clusters, sometimes paired, clusters sometimes appearing racemose, from the reduction of the leaves on special branchlets. Male sepals 5, imbricate, 3 inner often larger and sub-petaloid, disc of 5 fleshy glands, stamens 4–7 or usually 5, free or inner 2–3 with connate filaments, anthers with cells obliquely adnate or parallel, dehiscence longitudinal. Female flower like the male in size, perianth and disc glands. Ovary 5–12-celled, with as many minute, sessile, fleshy stigmas, or half as many 2-lobed stigmas. Ovules 2, superposed in each cell. Fruit with fleshy exocarp and softly coriaceous 5–12-celled endocarp, seeds usually fewer than twice the number of cells.

1. **K. reticulata,** *Baill.* Syn. Phyllanthus reticulatus, *Poir.*; Panjoli, *H.*, *Beng.*; Jandaki, *Or.*

A sarmentose shrub with slender, glabrous or pubescent branches, and elliptic or oblong leaves, ·5–1·75″ long. Flowers green or purple, campanulate, male and female sub-similar on slender pedicels, ·15–·25″ long, usually one male and one female in each axil,

9

sometimes racemed, inner sepals ·05–·06″ long, elliptic, rather broader and often orbicular in fruit in the female, up to ·075″ in fruit. Berries black, ·2″ diam., usually 8–10-seeded.

Throughout the whole area, chiefly in hedges along nalas. Fls., Fr. most of the year, chiefly Feb.–May, more or less leafless Jan.–Feb.

Leaves sometimes attain 3″ in length, rounded both ends, pale beneath, dark green above, sec. n. 6–8, slender. Petiole ·1–·15″. Stipules lanceolate, shorter than or equalling the petiole, occasionally hardening.

31. GLOCHIDION, *Forst.*

Trees or shrubs, usually evergreen, and with alternate bifarious, entire shortly petioled leaves. Flowers small in axillary clusters, usually monœcious. Male flowers usually yellowish, with 6, rarely 5, spreading sepals in two series, anthers connivent or connate in a sessile or sub-sessile column, with longitudinal dehiscence, connectives more or less produced with free tips or connate in a small head. Disc 0. Pistillodes usually 0. Female: calyx shortly tubular, 6-toothed or cleft, or sepals 2-seriate, nearly free. Ovary 3–15-celled, styles connate in a column, lobed or toothed at the tip, or minute sunk in the depressed crown of the ovary. Ovules two in each cell. Fruit of three or more 2-valved cocci with epicarp sometimes separately dehiscent, lobes of fruit often twice as many as the cells. Seeds usually laterally compressed, sometimes with a red aril-like coat.

I. Fr. much depressed, distinctly lobed, intruded both ends.
  Glabrous shrub. St. 4–12, connectives very short . . 1. *multiloculare.*
  Small pubescent tree. St. 3, connectives long, white : 2. *velutinum.*
II. Fr. not much depressed nor intruded at the ends, not deeply lobed when fresh.
  A. Glabrous small trees.
    1. Stamens 3, connectives umbonate. Fr. ·2″ diam. . 3. *assamicum.*
    2. Stamens over 3. Fr. over ·25″ diam.
    L. 3–6″, base cuneate. Connectives long. Fr. ·6–·7″ . 4. *lanceolarium.*
    L. 4–9″, base rounded (at least on one side). Connectives free, but very short. Fr. ·3–·4″ diam. . . . . 5. *zeylanicum.*
  B. Tomentose or pubescent small trees, otherwise as in 5. . Var. *Talboti.*

1. **G. multiloculare,** *Muell. Arg.* Nanha-bania-Kandhum, S.

A dwarf usually gregarious bush 3–4 ft. high, with the twigs sharply usually 2-angled and flexuous. Leaves 2–5″ long, lanceolate, linear-oblong or narrowly obovate, glaucous, sometimes purplish beneath, secondary nerves oblique, 5–7, slender. Male flower small, shortly pedicelled, with 4–12 anthers, female flower large, stoutly pedicelled, calyx ·37″ diam. in fruit which is ·75–1″ diam., 10-15-lobed, intruded base and apex.

In the moister regions, and usually in grass lands. Champaran! to Purneah! Monghyr, *Ham.*! Manbhum and Santal Parganas, near river beds! Fls., Fr. April–Oct. Evergreen.

Leaves acute or obtuse apiculate, tertiary nerves numerous, sub-parallel, raised beneath but fine. Petiole ·1″. Male fls. ·12″ diam., sepals oblong. The male inflorescence is often monstrous, of numerous short branchlets, clothed with imbricating bracts. Style a depressed cone or umbo with hollowed top, rayed. Capsule three times as broad as high, with thin separable epicarp and the cocci also falling away from the conical carpophore, leaving the red arilled seeds attached to the axis.

2. **G. velutinum,** *Wight.*

A small tree with nearly all parts pubescent or tomentose. Leaves 3–6″ (sometimes smaller at base of shoots), elliptic to oblong or oblong-lanceolate, sometimes oblique, base usually cuneate, apex acuminate or with a short rounded tip, persistently pubescent on the nerves beneath, secondary nerves 4–7 strong, united by scalariform tertiaries. Monœcious or sometimes diœcious, males yellow, ·17–·19″ diam., sepals and petals subequal, pale yellow, narrowly oblong-lanceolate, obtuse, outside pubescent, anthers 3, connectives produced into a broad subulate white point, about one-third as long as the cells. Female green, sepals 6, very pubescent, linear to oblong, stylar column in the very young flower often as broad as the ovary, and longer than the small sepals, or somewhat narrower than the ovary, often far exserted, pubescent except at the tip, terete, or slightly dilated above, stigmas 4–6. Capsules ·3–·4″ diam., flattened and depressed both ends, fruiting pedicels ·1–·3″.

Champaran Hills! Singbhum, in valleys, not common! Usually on the higher hills, Ranchi and Palamau, elev. 2000 ft. and above! Hazaribagh, on Parasnath! Sambalpur, occasional! Fls. on the new shoots April-May. Fr. June-Aug.

Bark brown and rough, blaze crimson. Twigs often hirsute pubescent. Leaves sometimes ovate, base rounded or acute. In a high Ranchi form (Ichadagh) somewhat falcate, obtuse or obtusely acuminate, glabrous between the nerves when mature. Petiole ·15–·3″. Stipules subulate. Male pedicels ·25–·4″, fem. in flower, ·1–·2″ long. Capsule usually 10-lobed, pericarp dehiscent on the tree, leaving the red seeds attached to the axis.

3. **G. assamicum,** *Hook f.*

A small leafy tree, with angled or almost 2-winged green branchlets, sometimes slightly pendent. Leaves usually 3–5″ at flowering time, afterwards 4–6″, elliptic-oblong, acuminate or cuspidate, with rounded or oblique base, mature often very like those of *G. lanceolarium*, shining both sides with 3–5 secondary nerves. Male and female flowers from the same axils. Male glabrous, ·12″ diam., on slender capillary ·3–·5″ long pedicels, anthers 3, connate, very short, with connectives terminating in an umbo. Females often very numerous, sepals 6, nearly free, erect, alternate larger, outside hispid. Ovary 4-5-lobed, sessile, pubescent, style conical, short, glabrous, 8-sulcate, and apex 8-toothed. Fruits ·2″ diam., usually crowded at the axils, with 4, rarely 5, sometimes only 3 loculi.

Bettiah, *Hieronymus*! Ramnagar! Fls. April-May. Fr. Oct.-March. Probably also Purneah.

4. **G. lanceolarium,** *Dalz.* Bania-Kandhum, *S.*; Kalchua, Chikni, *Or.*

A small glabrous tree, or often flowering as a shrub, with green rather flexuous and angular twigs, coriaceous dark green (grey-green when dry) shining leaves, usually narrowly-elliptic or elliptic acuminate, or oblanceolate, 3–6″ long, with usually obliquely cuneate base and slender secondary nerves, curving up within the margin. Male flowers numerous, clustered, axillary, yellowish, ·2–·3″ diam., on slender pedicels, ·3–·7″ long, with 4–6 anthers. Female flower green, 1–3 or more together, ·12″ long, narrow-

campanulate. Capsule orbicular, somewhat depressed, ·65-·7″ diam., pale, not deeply lobed, sessile or pedicelled.

Champaran, not very common! Gaya! Santal Parganas! Common throughout Chota Nagpur, especially along streams! Frequent throughout Orissa! Sambalpur! Fls. March-May. Fr. Sept.-Jan. New shoots in March. Evergreen.

Bark smooth grey, striate, with a delicate pink blaze, reddish on the wood. Leaves mostly 4·5-6·5″, rarely attaining 7″ by 3·5″, those at base of twigs much smaller and relatively broader; sometimes oblong or broadly elliptic and cuspidate. Petiole ·25″. Stipules ·12″, acuminate, sometimes hardened. Perianth 2-seriate, outer spreading, inner often erect, male sepals narrowly oblong, connectives long, subulate, as long as the cells, free. Fem. outer sepals oblong lanceolate, 3-4, inner narrower. Ovary stalked, villous, styles united into a 6-8-toothed tube, pubescent without, swollen below. The red seeds often persist after dehiscence of the capsule.

"Bark given medicinally when the stomach revolts against food," *Camp.* The seeds give an oil used for burning.

The fruits are sometimes converted into large crimson 6-8-celled bodies, without seeds, due doubtless to a parasite.

5. **G. zeylanicum,** *A. Juss.* Syn. G. tomentosum, *Dalz.* (in part).

A small tree, quite glabrous or densely pubescent, with shining ovate-lanceolate, or oblong, often curved or oblique leaves, attaining 9″ by 3·75″, with rounded or cordate base on one or both sides and acute or shortly acuminate apex, secondary nerves 6-9, petiole short, stout, ·15-·25″. Flowers monœcious. Male ·25″ diam., yellowish-green or reddish on pedicels ·25″ long, stamens 5-7, not connate but connivent, filaments hardly any, connective shortly produced, with short free tips, pistillode small. Female outer sepals erect, reddish, suborbicular, stylar column with 5-6 minute lobes. Fruit ·3-·4″ diam., depressed globose, not lobed (when fresh: it is in the herbarium), apex not intruded, beaked by the stylar column, pedicel scarcely ·2″ long.

Along streams. Athmallik! Sambalpur (Katabaga and Hathibari forests)! Fls. Feb.-May. Fr. may be found up to the following flowering season. Evergreen.

Attains 2·5 ft. girth. Bark dark. Leaves sometimes bullate, those at base of twig often only 3″, tertiary nerves scalariform, stipules small, subulate hardened and sometimes recurved or deciduous. Male flowers several in same clusters with female in usually supra-axillary clusters, sepals imbricate in bud, ·13″ long, broadly elliptic-oblong recurved, inner narrowly obovate-oblong, adnate at base with the outer. Fem. outer sepals erect, suborbicular, inner larger, oblong, pedicels shorter and stouter than in male. Frt. sometimes slightly 5-6-gonous, epicarp thin, rupturing before the deeply lobed endocarp.

Var. **nitidum,** *Dalz. & Gibs.* Quite glabrous. The localities quoted above.

Var. **typica**. Pubescent. Mayurbhanj, *Hooper*! Angul!

Var. **Talbotii.** Syn. G. tomentosum, var. Talbotii, *F.B.I.*

Leaves grey tomentose or densely hairy on the nerves beneath, less so between, above thinly hairy. Lower stipules ovate, upper lanceolate acuminate, ·15″, often reflexed, petioles tomentosely-hairy, ·2″. Male outer sepals broadly ovate, ·12″, inner ·07″, nearly glabrous, ovate-oblong.

Along streams. Athmallik!

Cooke says that the fls. are in supra-axillary umbels in *zeylanicum* and axillary in *G. tomentosum*. Specimens do not confirm this difference.

32. BREYNIA, *Forst.*

Shrubs or small trees, with leaves small, entire, and often resembling pinnate leaves. Flowers minute or very small, monœcious. Male turbinate, truncate, fleshy, with the small rounded sepals inserted towards the centre of the truncate top, which is often slightly lobulate at the margin, sepals 5–6, usually inflected, and nearly closing the mouth. Stamens connate into a sub-sessile column, with the three 2-celled anthers closely connivent or connate, connective not or slightly produced, dehiscence longitudinal. Female flower with turbinate, campanulate, or with coriaceous rotate broadly 5-6-lobed calyx, sometimes very much larger than in the male, and accrescent in fruit, disc 0 in either sex. Ovary globose or truncate, or depressed at the top, 3-celled, with either 3 sessile or sub-sessile 2-lobed spreading or inflexed styles, or stigmas 3 minute, sessile, sunk in the fleshy top of the ovary. Ovules 2 in each cell. Fruit more or less fleshy and coloured, 6-valved, or with 3–6-cocci. Cotyledons broad, radicle long.

Not always easily separable from *Sauropus*. *Pax* (in *Nat. Pflanz. Fam.*) distinguishes it by the calyx at the base not being thickened by union with disc-glands or scales, whereas in *Sauropus* the calyx-lobes are strongly thickened in this way.*

M. fl. ·08″. Fem. fl. campanulate, calyx in fruit small . . . 1. *rhamnoides.*
M. fl. ·1–·17″. Fem. fl. rotate, ·2″ diam. to ·5″ diam. in fruit.
Styles short spreading 2-lobed . . . . 2. *patens.*
Calyx of *patens*, but stigmas minute sessile as in 1 . . . 3. *cernua.*

1. **B. rhamnoides,** *Muell.* Kadrupala, Karki, *S.*; Jajan, *Or.*

A pretty shrub when well grown, 4–10 ft. high, with the spreading branchlets resembling pinnate leaves. Leaves close-set, distichous, glabrous, ·3–1″ long, or sometimes attaining 2·2″. Flowers minute, monœcious, or rarely diœcious, green, yellow or pinkish, solitary, rarely in axillary few-flowered clusters, male and female often on separate twigs. Male turbinate, ·08″, with the inflected lobes nearly closing the mouth. Female solitary, always green, campanulate, 6-lobed, with a large ovary soon exceeding the erect calyx, with a fleshy raised rim more or less 5–6-lobed, inside which are 3 inflected stigmas or rarely 5. Berries red, usually numerous, but only one from each axil, ·2″ diam., globose-ovoid or globose with a hollowed umbo, seated on the enlarged spreading calyx, which, however, is not as broad as the diameter of the fruit.

Throughout the Province but not at all common, chiefly in moist open glades. Ramnagar forests! Muzafferpur (with sarmentose branches)! Santal Parganas along streams, frequent in the North! Manbhum! Athmallik State! Puri, frequent!

Fls. March–Dec. Fr. March–Jan., practically all the year. Evergreen.

Bark light-coloured. Shoots often 2-edged but without raised angles from the stipules. L. elliptic-ovate or elliptic, rounded or somewhat retuse, pale beneath, base obtuse or cuneate, rarely rounded, sec. n. 3-5, fine, tertiaries very fine, not much reticulate, often joining up the secondaries. Petiole ·1–·15″. Stipules very short triangular or ovate-acuminate. M. fls. sometimes on minute shoots closely clothed with bracts, pedicels ·1″. Fem. sepals from triangular-ovate to cordate (in same flower). Ovules linear or linear-oblong.

---

* See note under *Sauropus.*

2. **B. patens,** *Benth.* Jajan, *Or.*

A pretty little shrub, 3–4 ft. high, somewhat resembling the last superficially, from which it may easily be distinguished by the young branchlets having a raised pair of lines from the stipules, as well as from the petioles, so that they are 4-angular, the male flowers are larger and more numerous, usually 2–3 from an axil, ·1–·17″ long, with the anther columns often exserted, and with more slender pedicels. Female much larger, the calyx spreading from the first, ·2″ diam., enlarging to ·5″ diam. in fruit. Pistil very different, the style being central, with 3 spreading 2-fid short arms. Fruit flattened both ends, brilliant carmine when ripe, ·3″ diam. on the crimson calyx.

Rare in our area. Puri, fairly frequent in open jungle! Possibly occurs in Northern Purneah. The Chota Nagpur locality in *Bengal Plants* and *F.C.N.* seems to be an error, Campbell's specimen being *B. rhamnoides*! Fls. Fr. April–July.
L. mostly elliptic-oblong, ·5–·8″. Sec. n. 2–4, usually 1 from base. Stipules lanceolate. M. fl. often ·1″ diam. at mouth, pedicels ·2–·25″, filiform. Fem. sepals broadly obovate, pedicels shorter, stouter, in fruit ·2″ and clavate upwards.

3. **B. cernua,** *Muell. Arg.* Syn. Phyllanthus cernuus, *Poir.*; P. nivosus, *W. G. Smith* (an excellent figure in *Floral Magazine*, 1874), the name usually given in horticultural gardens.

A pretty shrub, with leaves somewhat like those of *B. rhamnoides*, elliptic or broadly ovate, 1–2″ long, with rounded tip, and obtuse to retuse base. It is conspicuous by the new shoots and their young leaves being pink or white.

Very commonly grown in gardens and verandahs. Fls. April. It is apparently a native of Polynesia (Timor).
Older branches with red-brown striate bark. Stipules linear-subulate. Fls. solitary monœcious. Male perianth turbinate truncate, lobes round the mouth erect rounded, staminal column shortly stipitate, connective slightly produced, truncate, 3-gonous. Fem. perianth ·3″ diam. even before fruiting, salver-shaped, with 5 shallow retuse lobes and the ovary turbinate slightly 3-lobed truncate, sessile in the tube, stigmas 3, fleshy, minute, inflexed very minutely 2-lobed.

33. SAUROPUS, *Blume.*

Shrubs or undershrubs with distichous entire leaves as in *Breynia*, but often moderate sized. Flowers axillary, monœcious, solitary or clustered. Male flower turbinate, disciform or urceolate, outer rim entire or deeply lobed, inner edge with 6 minute lobes or thickenings towards the centre which meet closely round the staminal column, often covering it in bud. Stamens 3, combined into a 3-gonous truncate column, with the discrete anthers sessile on the angles, cells linear or subglobose-oblong. Female flower often larger, perianth 6-cleft, persistent accrescent. Ovary ovoid or globose, with rounded or concave top, 3-celled, styles 3, usually on the broad margin of the ovary, sessile depressed, spreading with 3 recurved or incurved arms. Ovules 2 in each cell. Fruit globose or depressed, fleshy or coriaceous, 6-valved or rupturing irregularly, with 6 indehiscent 3-gonous cocci.

There appears to me to be no essential difference in the structure of the calyx in *Breynia* and *Sauropus*. The outer rim of the calyx is often slightly lobed in *Breynia*; it varies from sub-entire to very deeply lobed in *Sauropus*; the so-called

uperficial thickenings or scales in *Sauropus* are homologous with the so-called epals or perianth lobes in *Breynia*. The best distinction of the genera unless they e reconstituted and arranged according to the condition of sessile stigmas or -lobed styles, appears to be the three-gonous column with discrete anthers and he discrete styles in *Sauropus*, the anthers in *Breynia* are sub-connivent round he terete column and more elongate, the stigmas or bases of the styles are central. 'he perianth of the female flower is also usually more deeply lobed in *Sauropus* han in *Breynia*.

Outer perianth lobes broadly oblong, retuse. L. pubescent . 1. *pubescens*.
Outer perianth lobes linear-oblong. Leaves glabrous . . 2. *quadrangularis*.

. **S. pubescens,** *Hook f.*

An erect undershrub, 3–4 ft. high, often tomentose when young, ranchlets compressed, often 2-ridged or sub-alate, permanently ubescent, leaves small, broadly ovate or elliptic, ·5–1·25″ long, ubescent beneath even when old, distichously arranged on the bliquely spreading short branchlets. Flowers minute, red, ·08–·1″ iam., perianth lobes of male obovate retuse, with inflected ounded ligule or scale (or sepal? see above) on a level with the top f the staminal column, alternately over the grooves and opposite he anthers, the former larger, cells very shortly oblong. Female ower larger with rounded orbicular-obovate lobes, style arms very hort incurved. Fruit sub-baccate, ·25″, ovoid with truncate top.

Ramnagar! Purneah (probably; it occurs close to the boundary!). Singbhum, in alas! Mayurbhanj (Baripada, *Hooper*)! Fls. May–July. Fr. with the later owers. Deciduous in February.

Leaves acute or sub-obtuse with rounded base, margins thickened or recurved, ec. n. about 3 fine looping. Petiole minute. Stipules and bracts minute, ersistent. Usually one male and one female at each axil. Fem. fl. ·15–·2″

. **S. quadrangularis,** *Muell.*

A glabrous undershrub, 1–2 ft., with habit of last. Leaves thin, lliptic or obovate, or orbicular-obovate rounded at tip, sometimes ith a short obtuse tip, rarely acute. Male flowers minute, stellate, ·07–·08″ diam., with spreading linear-oblong lobes with small hickenings at their base and prominent 3-angled staminal column. 'emale flower ·25″, with large orbicular obovate lobes and 3 ivergent 2-lobed styles. Fruit globose, ·3″ diam., depressed, narrower han the accrescent calyx.

Manbhum (Tundi Hills), *Camp.*! Karakpur Hills (Monghyr), *Ham.* Fls. Aug.

34. PUTRANJIVA, *Wall.*

Trees with alternate, entire or serrulate penninerved leaves, with inute caducous stipules. Flowers inconspicuous, monœcious, or (in ll our specimens) diœcious, apetalous, males clustered, axillary, or t the axils of caducous bracts on the new shoots, females long-eduncled, usually solitary, axillary, disc 0. Calyx 3–6-lobed or partite, lobes unequal imbricate, disc 0. Male with 2–4 central tamens, anthers large, erect. Female with 2–3-celled ovary, and as any styles, with large, fan-shaped, papillose stigmas. Ovules 2 in ach cell. Fruit a globose or ovoid drupe with hard 1-celled and -seeded endocarp. Seed ovoid with crustaceous testa, albumen eshy, cotyledons flat, somewhat curved in the middle, broad.

1. **P. Roxburghii,** *Wall.* Pitonj, *S.*; Piten (in Hazaribagh); Putranjiva, Jiaputa, *Beng.*; Poitundia, Poichandia, *Or.*

A large or moderate-sized handsome tree, frequently with somewhat drooping branches. Leaves bifarious, broadly lanceolate or oblong-lanceolate, 1–3·5″, often with a wavy or serrulate margin, base obtuse or rounded, nerves very fine, petiole ·2–·35″. Male flowers in numerous, minute, yellow axillary heads or contracted racemes, often on leafless axillary shoots and on previous year's wood. Female flower green, solitary on current year's shoots or in few-flowered racemes on the previous year's. Ovary white tomentose. Drupe ellipsoid, hoary, ·6–·7″, crowned with the style bases, pedicels ·5–1″ long.

N. Champaran, in mixed forest, apparently wild! Purneah! Manbhum and S. P. apparently planted only as it is in several other districts and may often be seen on railway platforms! Common wild in the Mals of Puri! Angul! Fls. March–April. Fr. Jan.–March (following year). Evergreen.

Shoots and petioles pubescent or tomentose. Leaves shining above, glabrous or puberulous both sides, obtuse to acuminate, sec. n. about 12, very fine, soon looping and reticulate. M. sepals lanceolate or linear-oblong, ciliate, filaments more or less connate below. Fem. sepals entire or wider upwards and toothed, ·05–·07″ long, pedicels pubescent, sometimes 2 on a short peduncle.

The stones of the fruits are strung into rosaries and worn as a charm. A tree sown by me measured 31 ft. high and 19·8″ girth after 16 years. Leaves sometimes used for fodder. Wood not much used. Wt. 49 lbs. (*Gamble*).

35. CYCLOSTEMON, *Blume.*

Trees with alternate entire or crenulate penninerved leaves and minute caducous stipules. Flowers inconspicuous diœcious, axillary clustered or racemed in the male, or female solitary. Sepals 4–6 broad, the two outer in male covering the entire (globose) bud, petals 0. Male flower with few to many stamens on the outer margin of a slightly thickened disc, or among the scales of the disc or (teste *F.B.I.*) inserted round a flattened or depressed disc, anthers large with vertical dehiscence. Pistillode 0 or minute. Female flower disc annular or failing. Ovary 2–4-celled, stigmas 2–4, dilated, fleshy or connate and peltate, with or without styles. Ovules 2 in each cell. Fruit subglobose, or ovoid, or somewhat didymous, indehiscent, with coriaceous or hardened pericarp. Seeds solitary in the cells.

1. **C. assamicus,** *Hook f.*

A small, much branched evergreen tree, with deep green glabrous shining elliptic-lanceolate, elliptic-oblong to ovate-lanceolate leaves, 3–6·5″ by 1·5–3″ and greenish flowers. Males clustered, ·25″ diam., with 7–10 stamens on the margins of a depressed glabrous disc. Female solitary, sessile, with rather thick, broadly shallowly lobed perianth, with pubescent margins and densely brown tomentose ovary. Fruit scarlet, ovoid-oblong, somewhat didymous, ·5–·75″ long.

Along nalas and in ravines. Sameshwar Hills, Champaran! Tholakabad Forest, Singbhum! Southern Range, Puri! Fls. Nov.–Dec. Fr. ripens April.

Bark light-cold., blaze white, slightly yellow-streaked. Buds, shoots and petiole rusty pubescent. Leaves rarely attain 9·5″, shortly acuminate, with rounded or acute, usually oblique base, sec. n. 7–10, very fine, obscure with reticulate nervules, petiole ·25–·35″. Mature male with 2 outer orbicular sepals

appressed hairy and ciliate and 2–3 inner imbricate larger ones. Disc thin hirsute on the margin (according to a field note, but my specimens seem glabrous), fil. and connective pubescent (always?). Stigmas 2, large, fleshy, subsessile, half-orbicular. Epicarp coriaceous, endocarp pulpy, seed with hard coriaceous testa.

36. APOROSA, *Blume.*

Trees with alternate, entire, rarely sinuate-toothed, penninerved leaves with caducous stipules and sometimes two hairy stipellæ-like glands at the base of the leaf. Flowers minute, diœcious, apetalous. Males in axillary solitary or clustered catkin-like spikes. Fem. sessile or shortly pedicelled in stouter abbreviated bracteate spikes. Sepals usually 4 (3–6) in both sexes, but female larger, imbricate. Stamens 1–5, central, with capillary filaments and didymous anthers. Ovary 2-, rarely 3-celled, stigmas small plumose, simple or 2–4-cleft. Ovules 2 in each cell. Fruit coriaceous or fleshy, sometimes partially 2–4-valved when dry, endocarp thin, often separable, cells sometimes hairy within. Seeds oblong or suborbicular, with sometimes fleshy testa.

1. **A. dioica,** *Muell.* Syn. A. Roxburghii, *Baill.*; Alnus dioica, *Roxb.*; Mossu, *Or.* (from confusion with *Saccopetalum*).

A small bushy tree, with entire shining oblong or elliptic-oblong, or oblong-lanceolate obtuse or acuminate leaves, very variable in size, often only 3–4·5″ in trees in the open, but 5–6″, or even 7″, in shady localities, coriaceous, ultimately glabrous; secondary nerves 6–9, oblique and looped, depressed above. Petiole ·4–·6″, often thickened at the top. Male flowers very minute, in 1–3-nate spikes ·7–1″ long from the axils and scars of fallen leaves on the old branches, bracts orbicular, brown edged, slightly brown-hairy. Female sessile or subsessile, usually about 4–6 from the upper bracts of a short ovoid spike ·3″ long, bracts glabrous ciliate, ovary hairy, 2-celled with 4-cleft stigma. Fruit ovoid-oblong, thinly rusty-villous, ·4″ long, 2-celled with hairy septum, seeds with orange-coloured testa.

N. Purneah, common! Mayurbhanj, near streams, 2000 ft.! Mals of Puri, frequent in evergreen forest! Fls. Feb.–April. Fr. April–May. Evergreen. Bark nearly smooth grey-brown or rough in old trees, blaze dark brown, then deep red, then yellowish or (in the Puri tree) hard light brown. Young leaves (Puri) rusty silky on the nerves and gland-toothed with deciduous tufts of hair at the glands, stipules ·3–·45″, rusty-villous, unequal-sided, only ·2″ in the Purneah tree, ovate-oblong.

37. ANTIDESMA, *L.*

Small trees or shrubs with entire stipulate leaves and small or minute diœcious flowers in slender spikes or racemes produced on the new shoots and sometimes panicled. Calyx 3–5-, rarely 7-lobed or -partite. Stamens 2–5, rarely 6–7, inserted on or inside the often lobed or annular disc, bases sometimes combined in a short column below the pistillode, anther cells globose or globose-oblong, usually terminal on a broad connective. Ovary 1-, rarely more-celled, stigmas 2–4, 2-lobed sometimes on a short style. Ovules 2, pendulous. Fruit a small, more or less compressed drupe.

I. Leaves acute or acuminate one or both ends, glabrescent.
  A. Racemes or spikes mostly solitary.
    Shrub. Rhachis glabrous. Fls. pedicelled, calyx glabrous outside . . . . 1. *diandra.*
    Tree. Rhachis hairy. M. fl. sessile, calyx hairy . . 2. *bunius.*
  B. Racemes mostly panicled.
    Tree. Rhachis pubescent. Fls. shortly pedicelled . . 3. *acuminatum.*
II. Leaves rounded both ends. Racemes panicled, tomentose . 4. *ghæsembilla.*

1. **A. diandrum,** *Roth.* Mata-ara, Mata-sura, *K.*; Matha arak', *S.*; Amti, *H.*, *Kharw.*; Archal, *Th.*; Matta, *Beng.*; Amtua sag, *Mal Pah.*; Marmuri, Kundui, *Or.*

A large shrub usually glabrous except the shoots, with obovate-lanceolate or somewhat rhomboidly-elliptic leaves, usually 1·5–3·5″ long, nearly always tapering at the tip to an acute or obtuse apex, base cuneate, shining especially beneath. Flowers minute, green, in mostly solitary, rarely 2–3-nate, racemes 1–2″ long or female 3″ in fruit, rhachis and sepals outside glabrous, disc and sepals inside usually pilose. Fruit sub-globose, ·14–·2″ diam., red to black, with a slightly compressed and rugose keeled seed.

Common in all districts. Chiefly in the valleys in hilly areas and near streams. Fls. May–June. Fr. Nov.–Jan. Leaves turn red from Jan. to March and then fall.

Shoots pubescent, and a form occurs in Chota Nagpur with the leaves permanently sub-tomentose beneath. L. pale beneath and shining with 3–5 slender sec. n. and others indistinct. Luxuriant specimens occasionally occur with leaves up to 7″ long, but these have only 5 or rarely 6 sec. n. and are acuminate with cuneate base. Petiole ·1–·2″. Stipules linear, much longer than petiole, caducous. Sepals usually 4. Stamens 2, rarely 3. Disc lobed glabrous, or usually pilose. Ovary glabrous.

The young leaves make an excellent spinach. The fruit is also eaten.

2. **A. bunius,** *Spreng.*

A small tree up to 30 ft. high and 3 ft. girth, with the twigs and buds somewhat fulvous hairy, especially near the leaf axils. Leaves 3–5″ long at time of flowering, ultimately 3–8″, elliptic-oblong or usually more or less obovate or oblanceolate and shortly acuminate, glabrescent and shining both sides, stipules very caducous ·1–·17″, falling as the leaves expand. Male flowers spicate, female racemed, spikes or racemes 2–4″ long, solitary or sometimes 2–3 together, usually terminating short branchlets, rarely lateral from leaf-scars. Male rhachis tomentose, flowers sessile, shallowly cupular sub-entire or shortly lobed, thinly hairy with thick lobed disc. Stamens 3–4, united at base into a short column beneath the clavate pistillode. Fruit elliptic compressed, ·25″, very juicy, red, turning black when ripe, seated on the cupular ciliate perianth with pedicels ·15″ long.

On the highest mountains only, in evergreen forest. Simlipahar, Mayurbhanj! Parasnath! Fls. April–May. Fr. Aug.

Bark smooth grey, blaze with chlorophyll, pinkish or pink, hard. Twigs and rhachis below the spike soon glabrous. L. shining both sides with 5–7 rather weak sec. n. not distinctly looping, tertiaries not at all raised. Petiole ·2–·4″. Bracts minute fleshy hairy, at some little distance below the pedicels. Fem. racemes thinly fulvous pubescent, calyx pulvinate cupular with minute thinly hairy limb, disc annular, ovary glabrous ovoid with 3–4, usually 4, rarely 5, sessile recurved obtuse stigmas.

3. **A. acuminatum,** *Wall.* Kath Jamrala, *Or.*

A small tree with tomentose buds and shoots. Leaves at time of flowering 3–5″ long, ultimately 4–12″, glabrous and shining, only the

very young slightly silky, oblong or slightly ovate-oblong acuminate, base usually rounded, secondary nerves 6–8, distinct, looping with each other close to margin, silky when young, petiole ·2″, stipules sub-persistent, linear, silky, ·25″ long. Flowers in terminal panicled spikes or racemes 2–3″ long at time of flowering, up to 4·5″ in fruit, rhachis pubescent, bracts small but distinct, subulate-lanceolate, silky, immediately at base of pedicels. Perianth 3–4-fid. Stamens 3–4.

Along streams in the Saranda Forests, Singbhum! Bonai, Cooper! Mayurbhanj! Fls. May. Fr. Sept. Evergreen or nearly so, renewing leaves at time of flowering.

Attains about 3 ft. girth. Easily distinguished from *A. bunius* by the deeply lobed calyx in both sexes, the panicled racemes and large stipules which are also found on the panicles. Leaves very dark green, sometimes 12″ long. Flowers unequally pedicelled, those of the male usually very short. Sepals glabrous in male, pubescent or ciliolate in female. Disc fleshy glabrous. Pistillode distinct in male and usually staminodes in female. Stigmas acute. Fruit elliptic acute ·2″ long on slender pedicels ·1–·12″ long. The pedicels in the male are late in development and care should be taken with specimens in bud not to confuse them with species with sessile flowers.

4. **A. ghæsembilla,** *Gaertn.* Mata-sura, *K.*; Amtua, *Kharw.*; Nuniari, *Or.*; Jamula, *Or*; also Kath-marmuri (in Angul).

A shrub, rarely a small tree, with broadly elliptic or orbicular or elliptic-oblong leaves, always rounded both ends, sometimes also with a short blunt acumen, 2–4·5″ long, grey- or hoary-tomentose when young, more or less pubescent or villous beneath when old with 3–6 strong secondary nerves. Flowers in densely tomentose panicled racemes, minutely pedicelled. Sepals woolly, stamens 4–7, disc and usually ovary pubescent or hairy. Fruit red to black, oblong, ·25″.

Common, in almost all districts! Champaran! Purneah! Gaya! Throughout Chota Nagpur! S.P.! Puri! Angul! Sambalpur! Mayurbhanj!

A plant of dryer localities than any of the other species, being often found on dry hill sides and in scrub jungles. Fls. May-June. Fr. Sept.-Oct. Deciduous before flowering.

Bark pale, smooth or slightly cracked, blaze pink. Leaves exceptionally 5·5–6″ long, never quite glabrous in our area, sometimes permanently sub-tomentose. Petiole ·17–·5″. Racemes ·75–2·5″ (the last in fruit). Perianth usually 5–7-partite, sometimes only 3-partite. Disc usually 5-partite

The fruit is eaten.

38. BACCAUREA, *Lour.*

Trees with alternate, entire or crenate-serrate, penninerved leaves, stipules covering the buds, caducous. Flowers diœcious, rarely monœcious, in simple or compound spiciform racemes or racemiform panicles, apetalous. Male flower sepals 4–5, usually unequal, imbricate. Stamens 4–8, filaments short, anthers didymous. Pistillode usually orbicular, pubescent. Female sepals 4–6, much larger than in the male. Ovary 2–5-celled with 2–5 papillose, 2–3-lobed or -cleft stigmas, free and sessile or with a short style, rarely connate and peltate. Ovules 2 in each cell. Fruit coriaceous, crustaceous or woody, 2–4-celled, tardily loculicidally dehiscent. Seeds broad, testa with a thick aril-like coat, albumen hard or fleshy.

1. **B. sapida,** *Muell.*

A small tree with light smooth bark. Leaves obovate, elliptic-obovate or oblanceolate, or some elliptic, entire or repand, obtuse or

I. Leaves acute or acuminate one or both ends, glabrescent.
  A. Racemes or spikes mostly solitary.
    Shrub. Rhachis glabrous. Fls. pedicelled, calyx glabrous outside . . . . 1. *diandra.*
    Tree. Rhachis hairy. M. fl. sessile, calyx hairy . . 2. *bunius.*
  B. Racemes mostly panicled.
    Tree. Rhachis pubescent. Fls. shortly pedicelled . . 3. *acuminatum.*
II. Leaves rounded both ends. Racemes panicled, tomentose . 4. *ghæsembilla.*

1. **A. diandrum,** *Roth.* Mata-ara, Mata-sura, *K.*; Matha arak', *S.*; Amti, *H.*, *Kharw.*; Archal, *Th.*; Matta, *Beng.*; Amtua sag, *Mal Pah.*; Marmuri, Kundui, *Or.*

A large shrub usually glabrous except the shoots, with obovate-lanceolate or somewhat rhomboidly-elliptic leaves, usually 1·5–3·5″ long, nearly always tapering at the tip to an acute or obtuse apex, base cuneate, shining especially beneath. Flowers minute, green, in mostly solitary, rarely 2–3-nate, racemes 1–2″ long or female 3″ in fruit, rhachis and sepals outside glabrous, disc and sepals inside usually pilose. Fruit sub-globose, ·14–·2″ diam., red to black, with a slightly compressed and rugose keeled seed.

Common in all districts. Chiefly in the valleys in hilly areas and near streams. Fls. May–June. Fr. Nov.–Jan. Leaves turn red from Jan. to March and then fall.

Shoots pubescent, and a form occurs in Chota Nagpur with the leaves permanently sub-tomentose beneath. L. pale beneath and shining with 3–5 slender sec. n. and others indistinct. Luxuriant specimens occasionally occur with leaves up to 7″ long, but these have only 5 or rarely 6 sec. n. and are acuminate with cuneate base. Petiole ·1–·2″. Stipules linear, much longer than petiole, caducous. Sepals usually 4. Stamens 2, rarely 3. Disc lobed glabrous, or usually pilose. Ovary glabrous.

The young leaves make an excellent spinach. The fruit is also eaten.

2. **A. bunius,** *Spreng.*

A small tree up to 30 ft. high and 3 ft. girth, with the twigs and buds somewhat fulvous hairy, especially near the leaf axils. Leaves 3–5″ long at time of flowering, ultimately 3–8″, elliptic-oblong or usually more or less obovate or oblanceolate and shortly acuminate, glabrescent and shining both sides, stipules very caducous ·1–·17″, falling as the leaves expand. Male flowers spicate, female racemed, spikes or racemes 2–4″ long, solitary or sometimes 2–3 together, usually terminating short branchlets, rarely lateral from leaf-scars. Male rhachis tomentose, flowers sessile, shallowly cupular sub-entire or shortly lobed, thinly hairy with thick lobed disc. Stamens 3–4, united at base into a short column beneath the clavate pistillode. Fruit elliptic compressed, ·25″, very juicy, red, turning black when ripe, seated on the cupular ciliate perianth with pedicels ·15″ long.

On the highest mountains only, in evergreen forest. Simlipahar, Mayurbhanj! Parasnath! Fls. April–May. Fr. Aug.

Bark smooth grey, blaze with chlorophyll, pinkish or pink, hard. Twigs and rhachis below the spike soon glabrous. L. shining both sides with 5–7 rather weak sec. n. not distinctly looping, tertiaries not at all raised. Petiole ·2–·4″. Bracts minute fleshy hairy, at some little distance below the pedicels. Fem. racemes thinly fulvous pubescent, calyx pulvinate cupular with minute thinly hairy limb, disc annular, ovary glabrous ovoid with 3–4, usually 4, rarely 5, sessile recurved obtuse stigmas.

3. **A. acuminatum,** *Wall.* Kath Jamrala, *Or.*

A small tree with tomentose buds and shoots. Leaves at time of flowering 3–5″ long, ultimately 4–12″, glabrous and shining, only the

very young slightly silky, oblong or slightly ovate-oblong acuminate, base usually rounded, secondary nerves 6–8, distinct, looping with each other close to margin, silky when young, petiole ·2″, stipules sub-persistent, linear, silky, ·25″ long. Flowers in terminal panicled spikes or racemes 2–3″ long at time of flowering, up to 4·5″ in fruit, rhachis pubescent, bracts small but distinct, subulate-lanceolate, silky, immediately at base of pedicels. Perianth 3–4-fid. Stamens 3–4.

Along streams in the Saranda Forests, Singbhum! Bonai, Cooper! Mayurbhanj! Fls. May. Fr. Sept. Evergreen or nearly so, renewing leaves at time of flowering.
Attains about 3 ft. girth. Easily distinguished from *A. bunius* by the deeply lobed calyx in both sexes, the panicled racemes and large stipules which are also found on the panicles. Leaves very dark green, sometimes 12″ long. Flowers unequally pedicelled, those of the male usually very short. Sepals glabrous in male, pubescent or ciliolate in female. Disc fleshy glabrous. Pistillode distinct in male and usually staminodes in female. Stigmas acute. Fruit elliptic acute ·2″ long on slender pedicels ·1–·12″ long. The pedicels in the male are late in development and care should be taken with specimens in bud not to confuse them with species with sessile flowers.

4. **A. ghæsembilla,** *Gaertn.* Mata-sura, *K.*; Amtua, *Kharw.*; Nuniari, *Or.*; Jamula, *Or*; also Kath-marmuri (in Angul).

A shrub, rarely a small tree, with broadly elliptic or orbicular or elliptic-oblong leaves, always rounded both ends, sometimes also with a short blunt acumen, 2–4·5″ long, grey- or hoary-tomentose when young, more or less pubescent or villous beneath when old with 3–6 strong secondary nerves. Flowers in densely tomentose panicled racemes, minutely pedicelled. Sepals woolly, stamens 4–7, disc and usually ovary pubescent or hairy. Fruit red to black, oblong, ·25″.

Common, in almost all districts! Champaran! Purneah! Gaya! Throughout Chota Nagpur! S.P.! Puri! Angul! Sambalpur! Mayurbhanj!
A plant of dryer localities than any of the other species, being often found on dry hill sides and in scrub jungles. Fls. May-June. Fr. Sept.-Oct. Deciduous before flowering.
Bark pale, smooth or slightly cracked, blaze pink. Leaves exceptionally 5·5–6″ long, never quite glabrous in our area, sometimes permanently sub-tomentose. Petiole ·17–·5″. Racemes ·75–2·5″ (the last in fruit). Perianth usually 5–7-partite, sometimes only 3-partite. Disc usually 5-partite
The fruit is eaten.

38. BACCAUREA, *Lour.*

Trees with alternate, entire or crenate-serrate, penninerved leaves, stipules covering the buds, caducous. Flowers diœcious, rarely monœcious, in simple or compound spiciform racemes or racemiform panicles, apetalous. Male flower sepals 4–5, usually unequal, imbricate. Stamens 4–8, filaments short, anthers didymous. Pistillode usually orbicular, pubescent. Female sepals 4–6, much larger than in the male. Ovary 2–5-celled with 2–5 papillose, 2–3-lobed or -cleft stigmas, free and sessile or with a short style, rarely connate and peltate. Ovules 2 in each cell. Fruit coriaceous, crustaceous or woody, 2–4-celled, tardily loculicidally dehiscent. Seeds broad, testa with a thick aril-like coat, albumen hard or fleshy.

1. **B. sapida,** *Muell.*

A small tree with light smooth bark. Leaves obovate, elliptic-obovate or oblanceolate, or some elliptic, entire or repand, obtuse or

acuminate, 4–8″ long, with a long petiole thickened both ends, glabrous (exc. the quite young). Racemes hoary-tomentose or pubescent from bract- and leaf-scars, sometimes from the trunk and old branches, when they are several together. Male flowers sub-sessile, ·15″ diam., solitary or grouped on very small lateral branches of the raceme in the axils of deciduous lanceolate stipular bracts, ·08–·17″ long, longer or shorter than the flower clusters; sepals 4, oblong or ovate, obtuse, pistillode large 3-lobed. Female flowers yellow, ·5″ diam., with oblong-oblanceolate, incurved, yellow, tomentose sepals, ·3″ long, articulate on ·18″ long pedicels in simple racemes 6–7″ long, elongating in fruit. Ovary strigosely tomentose, 3-celled; stigma large, peltate, scarcely lobed, almost fimbriate with large papillæ. Fruit globose-oblong, 1–1·2″, thinly hairy, terminated by three stigmatic scars, cells each with 1 large plano-convex seed, ·7″ long, with white aril and blood-red testa.

Probably in N. Purneah (it occurs close by)! Mayurbhanj, elev. 3000 ft.! Fls. April–May. Fr. following May. Evergreen.

Blaze flesh-cold. Buds and young twigs densely strigosely hairy. L. with about 8 rather prominent sec. n. The male flowers are contracted at the base and articulate, but can scarcely be said to be stalked.

39. BISCHOFIA, *Blume.*

One species only, easily recognised from its alternate 3-foliolate leaves and small flowers in lateral panicled racemes. Flowers diœcious. Sepals 5, orbicular, concave and hooded over the large anthers in bud, finally reflexed, caducous, ovate in the female. Disc 0. Stamens 5, one opposite each sepal, with very short filament, inserted under the peltate pistillode. Staminodes in female small or 0. Ovary 3–4-celled, with linear recurved styles. Ovules 2 in each cell. Fruit globose fleshy, with 3–4 cells lined with a parchment-like 2-valved endocarp. Seed oval.

1. **B. javanica,** *Blume.* Areng, *Th.*; Hajam, *M.*; Pader, *S.*

A moderate-sized tree with long-petioled 3-fol. leaves and crenate or serrate, rarely entire, elliptic-oblong to obovate leaflets, 3–6″ long, suddenly acuminate or caudate, glabrous, rather strongly nerved and sometimes with glands in the nerve-axils. Male flowers scattered and clustered on the panicle branches, anthers yellow. Fruit ·3″ diam., brown or black.

Not common but occurs throughout the province along streams. Fls. March–April. Fr. Oct.–Dec. Evergreen, new shoots March–April.

Bark dark, flaking when old, blaze pink with crimson juice, then whitish. Petiole 2·5–6″ long, terminal petiolules ·75–1·5″, lateral short. Panicles 3–4″ from the scale axils of the new shoots.

It is an excellent wood for planking and the ceilings of some forest rest-houses have been made from it.

40. EUPHORBIA, *L.* Spurge; Milk-bush.

Trees or shrubs, often with thick fleshy branches and stipular spines, with alternate leaves; or herbs of various habit with opposite or alternate leaves, always with milky juice. Leaves entire or toothed, sometimes pseudo-whorled, often caducous or reduced in the fleshy

species. Stipules present or not. Inflorescence composite. Male flowers of naked pedicelled stamens usually many together, frequently in 5 groups, in a calyx-like 4–5-lobed involucre, the lobes thin, sepaloid, entire or divided, alternating with large, rarely small, glandular processes forming an outer whorl, or in some cases glands solitary, and sometimes furnished with a petaloid expansion or limb or with horns. Involucres 1-sexual or usually 2-sexual, containing a solitary central female flower consisting of a pedicelled ovary, naked or sometimes with rudiments of a 3-merous calyx. Ovary 3-celled, more or less deeply 3-lobed, styles 3, free, or more or less connate, often 2-lobed or 2-fid, ovule 1 in each cell. Capsule of three 2-valved cocci, separating from a columella when ripe, fruiting pedicel elongate and usually decurved. Seed with or without a caruncle.

I. Fleshy trees or shrubs or (*fusiformis*) an undershrub with subterranean rootstock. Leaves alternate fleshy or 0. Inflor. not leafy (Sec. *Euphorbium*) :—
- A. Armed with stipular spines. Involucres in 2–3-chotomous cymes :—
  - 1. Branchlets not winged :—
    - Spines not on prominent tubercles. Antlers didymous, purple . . . . 1. *nivulia.*
    - Spines on prominent tubercles which are sub-confluent in 5 lines. L. obovate or spathulate 3–6″. Anthers apiculate . . . . 2. *neriifolia.*
    - Spines on distant tubercles. L. ovate to oblong-ovate. Anthers yellow, not apiculate, oblong or didymous . . . . 3. *caducifolia.*
  - 2. Branchlets 3- rarely 4–5-winged :—
    - End 3–6 joints of branches under 8″ long . . . 4. *antiquorum.*
    - Penultimate and preceding joints over 9″ long . . 5. *trigona.*
- B. Without spines :—
  - Aërial stem 0. Leaves and cymes as in *nivulia* . . 6. *fusiformis.*
  - Tree or shrub. L. very small. Involucres clustered . 7. *tirucalli.*

II. Shrubs or herbs, neither very fleshy nor umbellately branched. L. alternate or upper opposite. Involucres with a single large gland, often with brilliantly coloured bracts (Sec. *Poinsettia*) :—
- Garden shrub. Inflor. with brilliant scarlet bracts . 8. *pulcherrima.*
- Garden herb or undershrub. Bracts of inflor. parti-coloured . . . . 9. *heterophylla.*
- Introduced herb. Bracts mostly green or pale at base 10. *geniculata.*

III. Herbs umbellately branched above, upper leaves opp. or whorled. Involucres regular, glands not petaloid (Sec. *Tithymalus*) :—
- A. Final ramifications of inflorescence forming a sympodium on which the solitary involucres are axillary . 11. *perbracteata.*
- B. Inflorescence umbellate or dichasial throughout :—
  - Perennial. Invol. glabrous, lobes triangular, fimbriate . . . . 12. *prolifera.*
  - Annual. Invol. hairy within, lobes ovate ciliate . . 13. *dracunculoides.*

IV. Herbs, rarely umbellately branched, leaves all opposite with oblique base. Glands of invol. often with a petaloid limb or appendage.
- A. Involucres sub-solitary in the axils of the uppermost leaves which imbricate and conceal them :—
  - Erect. Limb of glands entire . . . . . . 14. *pycnostegia.*
  - Ascending. Limb of glands laciniate . . . . 15. *cristata.*
- B. Involucres cymose, cymes axillary and terminal. Leaves ·3–1·5″ :—
  - Glabrous or thinly pubescent. Cymes not capitate . 16. *hypericifolia.*
  - Hispidly pubescent. Cymes capitate . . . . 17. *hirta.*
  - Prostrate. Cymes few-involucred, sessile, pink . . 18. *rosea.*

C. Prostrate herbs with leaves under ·3″. Involucres solitary or clustered axillary :—
 1. Involucres pubescent :—
  L. ·15–·3″ crenulate . . . . 19. *thymifolia.*
  L. ·1–·14″ entire, villous . . . . . . 20. *granulata.*
 2. Involucres glabrous :—
  L. ·17–·25″ coriaceous, sometimes toothed at apex . 21. *microphylla.*

1. **E. nivulia,** *Ham.* Syn. E. nereifolia in *F.I. and Bombay Flora.** Sij, *Beng.*; Etke, *K., S.*

A tree 10–30 ft. high, with straight trunk and terete, jointed, spreading, often whorled branches, with straight geminate stipulary spines (or some unarmed). Pairs of spines inserted on flat brown or black corky areas, not on swellings of the branchlets. Leaves (usually only present in the r.s.) up to 9″ by 2·5″, fleshy, linear-oblanceolate or spathulate, obtuse, apiculate, base narrowly cuneate, nerves only visible by transmitted light. Petiole 0. Cyme about twice forked, borne at the leaf-scars towards the ends of the branchlets, 1·5″ long. Involucres yellow, anthers *purple* with yellow pollen. Stigmatic lobes flattened and slightly expanded. Capsule sharply 3-lobed, lobes compressed.

The common indigenous species, frequent on barren rocks and in rocky places from Shahabad! and the Gaya and Curruckpur hills! southwards. Santal P. on trap! Sambalpur, occasional even on the shales near nalas! Common on the quartz rocks of the Jhargati hills! Found in association with Sal in the Maniband forest, Puri! Fls. Feb.–April. Fr. April. Leafless Feb.–June or longer according to situation.

Bark thick rugose and corky on large trees. Stipular spines ·12–·3″ long, usually black. Cyme normally consists of a peduncle, ·3″ long, two sec. peduncles ·5″, each with two tertiary ped. ·3–·5″ long, bracts inconspicuous, upper oblong truncate keeled and toothed. First involucre usually disciform, male only, others sub-campanulate with a single female finally with recurved pedicel. Lobes and numerous bracteoles of the involucre fimbriate. Glands 5, fleshy, transversely oblong.

The milky juice is taken internally by the Kols as a violent purgative in cases of fever.

2. **E. neriifolia,** *L.* Syn. E. ligularia, *Roxb.*; E. nivulia, *Cooke* in *Bombay Flora.** Etke, *K., S.*; Mansa-sij, *Beng.*

A large branched shrub or small tree, 6–15 ft. high, with the pairs of stipular spines on tubercles or swellings of the branchlets, these tubercles more or less confluent in five vertical or slightly spiral lines, so that the branch is more or less obtusely 5-gonous in section. Leaves obovate, very similar to those of the last species. Involucres yellowish, 3–7 in a cyme, usually 3, with a very short fleshy peduncle about ·15″ long. Oldest involucre, male, 2-bracteate, bearing in the bract axils a 2-sexual involucre, the opposite bracts of which may in their turn bear each a peduncle and are 3-lobed with central lobe toothed. Lobes of involucres broadly cuneate and fimbriate, much as in last species. Anthers sagittate, apiculate (*teste Roxburgh*), *colour not noted.* Fruit as in last. Style 3-fid, stigmas slightly dilated and minutely toothed. Fruit much as in last species.

Common in village hedges. Nowhere seen wild unless the next is its wild form. Fls., Fr. Feb.–April.

* Cooke follows Roxburgh in the nomenclature of these two species, but the Linnean description of *neriifolia* and his quotation of Commelin's figure, which exactly agrees, leaves no doubt that he was not referring to Hamilton's subsequently named *nivulia*, but to the common village form with tubercles in 5 rows.

3. **E. caducifolia,** *Haines.* in Indian Forester 40: 154 1914

A dense shrub with several stems from the root or densely branched close to the ground. Branchlets with small rather distant tubercles, not confluent, with a very black areole bearing two black stipular spines as in last. Leaves broadly-ovate with crisped margin, becoming more oblong-obovate and cuspidate with age, but not exceeding 2–3″ and then falling. Involucres solitary or 2–3 nate on very short fleshy peduncles, usually bearing a central male involucre and two pedicelled 2-sexual involucres, with very stout pedicels ·25″ long or ·4″ in fruit. Involucre ·17″ diam., lobes broadly oblong-obcuneate toothed, scarcely fimbriate. Anthers *yellow*, oblong with oblong or linear-oblong lobes and longitudinal dehiscence (or sometimes with the lobes erecto-patent or globose, possibly from a different species in the same locality). The male flowers are in 5 distinct groups (more visible when old) opposite the lobes. Styles connate for half their length then spreading with minutely 2-lobed stigmas.

Wild on rocks on the Puri coast! Fls., Fr., Jan.–April.

If the variation in the shape of the anthers indicated above is correct, this may be the wild form of *E. neriifolia*, but more observations *in situ* and more specimens are required; especially the colour of the anther in *neriifolia* should be noted. The pollen-grains are yellow, 3-grooved and in section 3-lobed. Ovary sharply 3-gonous, microscopically thinly papillose. Capsule ·2″ long, ·4–·5″ diam., with compressed cocci much as in last two species. Seed smooth, globose. The bracts of the 2-sexual involucres corresponding to the lobed bracts in *neriifolia* are concave and minutely toothed, not lobed. There is sometimes a rudiment of a 3-lobed calyx under the fruit.

4. **E. antiquorum,** *L.* Etke, *S.*; Tidhara-send, *H.*; Baj-varan, *Beng.*; Dokana-sij, *Or.*

A much branched small tree, 12–25 ft. high, with jointed branches and usually 3–, more rarely 4–5-winged branchlets, the wings repand-sinuate with short stipulary spines. Leaves fugacious and small, fleshy, obovate-oblong or spathulate, ·5″ long. Cymes usually short and 3-involucred only, longer in fruit, but once-forked and 7-involucred in vigorous specimens. Styles free, 2-lobed. Cocci compressed.

Not indigenous, except, perhaps, on the laterite in Khurda. Frequently seen in village hedges, especially in the south. Fls., Fr. Dec.–Jan. Leaves Aug.–Sept.

The joints in this species are short, especially towards the ends of the branches, where they are usually as broad as long.

5. **E. trigona,** *Haw.* *Vern.* names of last.

A tree, 10–20 ft. high, with ascending branches and 3-winged branchlets much as in the last species, but the wings less broad in proportion to the length of the joints, which bear more numerous small tubercles and geminate spines; the penultimate and older joints are nearly always over 9″ long, while the 3–6 last joints of *E. antiquorum* are under 8″ long. Leaves obcuneate, 1–2″ long, pale beneath.

Introduced only and now frequently planted on railway platforms (as is the last), in gardens, etc. Fls., Fr. Feb.–April.

Cymes mostly short and 3-involucred. Central one usually male only as in other species (in *E. antiquorum* the central one is described in *F.B.I.* as *female*; this is not in accordance with my observations). Anthers didymous. Styles shortly connate, stigmas emarginate.

6. **E. fusiformis,** *Ham.* Syn. E. acaulis, *Roxb.*

A dwarf species reduced to an underground rootstock, ·75–1·5″ diam., producing annually from its apex a crop of sessile or sub-sessile oblanceolate or broadly obovate-spathulate leaves, 6–8″ long by 1·3–3·8″ broad, the margins often crenulate-crisped. Involucres ·25″ diam., 3–7 in a short- or long-peduncled cyme which may be up to 6″ in length, lobes spathulate, fimbriate. Styles combined half-way. Capsule ·3″ diam.

Very common on white sandy soil in the forests of N. Champaran! Purneah, *Roxb.* Fls. April. Fl., Fr. March–May. The leaves appear in the rains and remain till December or January.

Except for its habit the plant reminds one altogether of the *nivulia-neriifolia* group.

7. **E. tirucalli,** *L.* Lanka-sij, *Beng.* (*tirucalli* is the Tamil name).

A small tree easily recognised from the erect branches and smooth, terete, polished, whorled or fascicled branchlets, not much thicker than a quill, which bear in the rainy season small linear-oblong leaves, ·25–·5″ long. Involucres clustered in the forks of the branchlets, shortly pedicelled, mostly female, campanulate, glands 5–3, transversely oval peltate, lobes short, hairy, bracteoles numerous, lacerate. Female woolly, styles short, recurved, 2-lobed. Capsule ·2″, cocci compressed, velvety. Seeds ovoid, smooth.

Naturalised in parts of Puri and frequent in village hedges, chiefly in the south. Fls., Fr. r.s.

8. **E. pulcherrima,** *Willd.* The Poinsettia.

A lax shrub, 10–15 ft. high, with leafy fistular branchlets. Leaves alternate, elliptic or oblong, 4–6″ long, repand-dentate. Involucres in corymbose cymes surrounded by brilliant scarlet foliaceous bracts (or, in variety *albida*, bracts white), involucres with a large, unilateral, ellipsoid, compressed, yellow gland.

Cultivated in all Indian gardens and one of the most ornamental shrubs when in flower. Fls. c. s. Native of Central America.

It is usually rigorously cut back after flowering or becomes very straggling and is easily propagated (like all the preceding species) from cuttings. Whether it ripens seed or not I do not know.

9. **E. heterophylla,** *L.*

A herb, 1–4 ft. high, like a dwarf *Poinsettia* but far less handsome. The leaves are almost lobed and the floral bracts are green, with the scarlet colouring never extending more than half-way up, often less. Here, also, the coloration may be white. The gland is single as in *E. pulcherrima*.

Common in gardens. Fls., Fr., all the year.

It is a native of America, where it is widely distributed. It seeds itself very readily in this province, becoming quite a weed in some gardens.

10. **E. geniculata,** *Orteg.* Syn. E. prunifolia, *Jacq.*

A herb, 2–3 ft. high, with long-petoiled, oblong-obovate, sub-entire, shallowly denticulate leaves, 3–4″ long, the lower alternate, the upper opposite with stipular glands, secondary nerves 12–18, fine

but distinct. Involucres very small, ·1″ long at flowering time, campanulate in dense corymbose cymes only ·7–1″ diam., with the subtending leaves whitish or pale near the base. Gland one, large-stalked, with expanded disciform hollow top.

Cultivated fields and sometimes in gardens! Fls., Fr. Aug.-Oct. Annual.

Internodes below the inflorescence usually very long. Lobes of involucre very broadly oblong lacerate, with often gland-tipped fimbriæ. Male fls. numerous without bracteoles, anthers broadly oblong with longitudinal dehiscence. Ovary glabrous, styles shortly connate, 2-fid, erect with subulate stigmas. Capsule smooth, seeds dark grey, truncate at the lower end.

11. **E. perbracteata,** *Gage.*

A rather coarse annual, 18–30″ high, with pale stems, 2–3-chotomously paniculately branched above, lower leaves alternate, sessile, narrow, oblong, 2″ long, deciduous, upper opposite, broader, those on the panicle ovate to orbicular, united at their base, about ·7″ broad and rounded at tip, with many nerves from the base, a pair at each fork and sub-imbricate on the final branches of the inflorescence. Stipules 0. Involucres solitary in the upper forks and cymosely subspicate (in scorpioid biparous cymes), one in each pair of bracts alternately each side of the rhachis (sympodium), very shortly pedicelled, tubular-campanulate, ·1″ long in flower, lobes membranous, small, 2-toothed, glands 4, truncate, broadly oblong, with a reflexed horn each side, petaloid limb 0.

Behar, *Kurz*! I have collected it in cultivated fields only as though introduced. Fls., Fr. Feb.-April.

Stamens few without hairs or bracteoles, the filament stouter than its slender pedicel, anther cells globose transversely, laterally dehiscent. Ovary glabrous, styles connate at base, 2-lobed, stigma slightly expanded. Cocci ·17″, smooth. Seed dark grey or brown marbled, ·1–·12″, caruncle deciduous.

12. **E. prolifera,** *Ham.*

Erect, herbaceous, from a woody rootstock with several stems 1–2 ft. high, with close linear leaves or scattered linear-oblong or oblong, or towards and on the inflorescence, ovate leaves. Inflorescence of several (usually 4–5) umbellately spreading branches, with a pseudo-whorl of leaves at its base and a terminal involucre; branches with a pair of leaves also terminating in an involucre. From the side of the involucres other lateral branches may either continue the inflorescence or are purely vegetative, so that after flowering and fruiting the plants are much paniculately branched above with leafy shoots (proliferous).

Higher plateaux of Chota Nagpur. Neterhat, elev. 3000 ft., frequent! Fls., Fr. April-June.

The new shoots after fires may have orbicular ovate leaves, ·5″ long, and a sub-verticil of sessile, broadly ovate leaves ·6–·7″ long supporting the young inflorescence. All involucres 2-sexual with one female, central involucre shortly stipitate, ·15″ diam. Glands 5–7, shortly stipitate, transversely oval and toothed or semi-lunate and 2-horned. Anther lobes oval, erecto-patent dehiscing across the top. Capsule 3-lobed, ·25″ long, with a pedicel ·2–·3″ long, styles 3, short recurved with 2-lobed stigmas.

13. **E. dracunculoides,** *Lamk.* Parwa, *S.*; Jychi, Chagulpuputi, *Beng.*

A glabrous annual, 4–8″, rarely 12–18″ high, with opposite or repeatedly dichotomous branches, often umbellate above. Leaves sessile, linear, linear-lanceolate or linear-oblong, ·7–2″ long, the lower alternate, secondary nerves not visible. Involucres solitary at the

10

forks, turbinate or campanulate, sub-sessile, glabrous without, hairy within, ·06″ long. Capsule ·15″ with pedicel about as long, cocci reticulato-venose with a median dorsal nerve, but scarcely keeled.

In fields. Bettiah! Behar, abundant, *J.D.H.*! Chota Nagpur, occasional! Fls., Fr. Nov.–March.

Leaves usually narrowed towards the base, floral usually shorter and broader. Glands transversely oblong 2-cornute, horns often slender, lobes ovate, denticulate, ciliate. Anther-cells globose. Styles as long as young ovary, 2-fid. Seeds tubercled, caruncle depressed.

14. **E. pycnostegia,** *Boiss.* Syn. E. zornioides (in *Bengal Plants*).

A slender erect annual, about 12–18″ high, with opposite oblong or linear-oblong leaves 1–1·5″ long, rounded at the apex, very minutely serrulate, glabrous, base oblique semi-cordate, secondary nerves very obscure. Involucres mostly solitary in the axils of the uppermost leaves, which are mostly distichously imbricate and sometimes pale between greener reticulations. Lobes of involucre toothed, glands with a large obovate petaloid limb. Seeds granulate.

Behar, *Kurz*! Fls., Fr. Sept. (in C. P.)

Youngest leaves slightly silky beneath in some specimens. Petiole hardly any. Stipules minute or indistinct.

15. **E. cristata,** *Heyne.*

A prostrate or ascending annual with slender stems, 6–10″ long, clothed with long flexuose hairs, often dichotomously branched above. Leaves opposite, covered with long flexuose hairs, ovate-cordate obtuse serrulate. Involucres sub-sessile, hairy, sub-solitary, in the axils of the uppermost leaves which are distichously imbricate, lobes linear-lanceolate, glands with a pectinate and fimbriate petaloid limb. Cocci globose.

Very rare. Behar, *Kurz*!

16. **E. hypericifolia,** *L.*

A herb of various habit with stems 6″ to 2 ft. long (or high), with oblong or somewhat obovate obtuse or rounded serrulate leaves under 1·7″ long, with oblique rounded or cordate base. Involucres campanulate minute, ·07″ long, in numerous small cymes, axillary or terminating short axillary branchlets, about ·5″ diam., with erect, narrow lanceolate bracts at all the nodes. Lobes of the involucre narrowly lanceolate, acuminate, longer than the shortly stipitate glands, which are 4–5, disciform, usually with a minute white or pink petaloid limb. Ovary and capsule glabrous, appressed hairy or hispid. Seeds smooth "or with shallow transverse pits" (*F.B.I.*).

A common weed in open situations, probably in all districts. Fls., Fr. Dec.–May, perhaps all the year round.

The following two varieties at first look distinct:

Var. *α*. A large form with sub-woody, sub-erect or ascending stems, puberulous branches, swollen nodes and lower leaves 1·5″ long crenulate above. Stipules subulate or setaceous. Involucre and ovary nearly glabrous. Petaloid limb minute, white, or apparently (in dried specimens) obsolete, the gland often pink. Chota Nagpur!

Var. *β*. Stems spreading, procumbent more pubescent, leaves ·5–·75″, appressed hairy beneath. Involucres pubescent, the lobes ciliate, glands with a distinct, but

small, pink petaloid limb. Chota Nagpur! A similar form in Purneah! but more erect.

Seeds of the last oblong, keeled opposite to the fine raphe, and with two depressed or flattened faces, grey (microscopically punctulate).

17. **E. hirta,** *L.* Syn. E. pilulifera (*F.B.I.*); Pusi-toa, *K.*, *S.*; Bara-kerui, *Beng.*

An erect or decumbent roughly hairy herb, 8″ to 2 ft. high, with opposite unequal-sided serrulate elliptic-oblong obovate or oblong-lanceolate leaves, ·75–1·5″ long, with acute or cuneate tip. Involucres minute, ·04–·05″ long, crowded in capitate finally peduncled axillary cymes, hairy, campanulate, with 4 shortly stipitate red-tipped glands without a limb or with a minute fleshy rounded green or white limb.

A common weed everywhere. Fls., Fr. all the year round, annual.

Pubescence often curly. Leaves sometimes sub-rhomboid, the upper extremity nearly always acute; one variety prostrate with leaves under 1″ long and with a black patch in the centre of each; lower surface pale and hispidly hairy on the 3–4 rather strong sub-flabellate nerves, hairs sometimes red or brown, those on the stem usually coarse and finer silky ones beneath. Petiole ·12–·2″ long. Stipules of glands or fimbriæ, minute. Cymes always congested, at first sub-sessile but peduncle elongate and finally sometimes forked and sometimes 1″ long, from nearly all the alternate axils. Involucre minute, only ·04″ long, strigose, lobes subulate ciliolate exceeding the minute stipitate glands or as long, glands scarcely dilated above, tip concave, sometimes with a distinct minute fleshy limb (without a perceptible limb, *F.B.I.*). Styles 2-fid to base. Capsule hairy, ·05″ long, seed oblong, reddish, 3-keeled and faintly transversely rugose.

The root is given to allay vomiting by the Santals, and the plant to nursing mothers as a galactagogue.

18. **E. rosea,** *Retz.* Syn. E. auricularia, *Boiss.*

A little herb with woody rootstock, many slender prostrate flexuous stems up to 12″ long from a perennial rootstock and opposite, coriaceous, obliquely obovate, oblanceolate-oblong, or linear-spathulate leaves ·3–·6″ long with rounded crenulate tip. Involucres solitary or few in small sessile cymes conspicuous from the general pink or purple colour of all its parts. Involucre ·12″, sub-campanulate, glabrous, lobes triangular-ovate, acute, 3–5-fid, glands with a conspicuous rosy limb. Styles deeply 2-fid, stigma spathulate. Capsule minutely tuberculate or smooth (in our plant). Seed keeled.

Sands of the Orissa coast between Puri and Konarak, common! Chilka Lake, *Alcock*!

This little plant is conspicuous in the rains when in flower from the rosy cymes. It has been named *E. auricularia, Boiss.* in the *Calcutta Herb.*, on account of the involucre and capsules being perfectly smooth, but Colonel Gage considers it scarcely distinct from *E. rosea* with which it is united in the *F.B.I.*

19. **E. thymifolia,** *L.* Nanha pusi-tuar, *S.*

A small herb with numerous horizontally spreading branches which are pubescent above and glabrous below, small, opposite, distichous, obliquely oblong, rounded, minutely crenulate leaves, ·15–·3″ long, and small axillary green or pinkish clusters of involucres without a common peduncle. Capsules erect, pubescent, ·03″.

Chiefly in the moister districts. Purneah! Singbhum! Manbhum, *Campbell*, *Kurz*! Ranchi, *Wood*! Perhaps in all the districts. Fls., Fr. r.s.

Stems often pink with short branches successively to the right and left from each alternate pair of leaves. Petiole minute. Stipules subulate, hairy. Involucres ·03″ turbinate pubescent, glands minute, stipitate, with or without a minute petaloid limb. Capsule erect, pubescent. Seeds with shallow transverse furrows.

20. **E. granulata,** *Forsk.* Kantha arak', *S.*

A small procumbent herb with many villously hairy stems, 2–8″ long, from a stout rootstock, villosely-hairy all over. Leaves minute, ·1–·15″, rarely ·2″, opp., broadly oblong with oblique base or somewhat obovate, apex obscurely denticulate, stipules scarious. Invol. minute, ·04″ long with oblong lobes, glands often without a limb. Capsule hairy, cocci with rounded backs. Seeds acutely oblong tetragonous, faintly pitted or rugulose-lacunose, sericeous.

Dry plains. Gangetic Plain! but no satisfactory specimens seen by me from our area. Chota Nagpur, *Prain.* Fls. Oct.–April.

21. **E. microphylla,** *Heyne.* Syn. E. serpens, var. indica, *Boiss.*

Very similar to *E. granulata*, but with slender root, glabrous or only sparingly villous, leaves usually larger, ·12–·24″, entire or toothed. Petiole distinct. Stipules subulate. Involucre minute, ·02″, lobes ovate very acute or mucronate, glands distinctly pedicelled. Styles spreading. Cocci distinctly keeled, glabrous or sparingly villous. Seeds ovate, acutely tetragonous, nearly smooth (undulately rugulose), whitish-blue.

Banks of stream, Behar, *J.D.H.*! Bettiah, *Hieronymus*! Fls., Fr. Sept.–March.

The Bettiah plant is villous and scarcely separable from *granulata*, except by the keeled cocci; glands narrow-elliptic, limb a mere rim, lobes minute lanceolate with small villi or bristles, styles very short, seeds transversely furrowed.

41. SYNADENIUM, *Boiss.*

Shrubs with unarmed terete fleshy branches and well-developed alternate entire somewhat fleshy leaves. Flowers reduced to single stamens in the male and a single ovary with or without a rudimentary perianth in the female, the males or males with a single female collected into capitula as in *Euphorbia*, but with the glands of the involucre completely fused with one another into a continuous fleshy ring; lobes (outer) of the involucre as in *Euphorbia*, but inner bracts surrounding groups of male flowers connate by their inner margins, thus forming an inner involucel round the female flower where present. Capsule 3-lobed. An African genus.

1. **S. Grantii,** *Hook. f.* Syn. S. umbellatum, *Pax.* African Milk Bush.

An erect bush, 6–7 ft. high, with green terete branches, the ultimate ones about ·3″ diam., and numerous oblanceolate or obovate scarcely fleshy leaves 3–6″ long, dark green and often clouded above with the very oblique secondary nerves much more evident than in the fleshy *Euphorbias*. Involucres in somewhat supra-axillary cymes, 2–6″ long at the uppermost axils, repeatedly forked or branches umbellately 3–5-nate, hairy above. Involucres ·3″ diam., saucer-shaped, red-purple, the pulvinate annulus (connate glands) entire or wavy, somewhat pubescent at base, densely covered with close papillæ on the inner side, lobes 5, erect, sub-quadrate, shortly fimbriate or toothed. Usually 2-sexual. Ovary tomentose. Perianth annular, sub-entire.

Common in hedges about Cuttack, and occasionally elsewhere in gardens! Fls. Fr. Jan.–Feb.

The distinctions described between *S. Grantii* and *S. umbellatum* disappear if a number of Indian specimens are examined growing freely. The leaf margins are ciliate, or the pubescence extends for some distance from the margin, which is

often incurved at the lower part and tapers into a short petiole. Involucres supported by scarious oblong truncate bracts, ·1–·15″ long. Involucel more or less villous.

42. PEDILANTHUS, *Neck.*

Somewhat fleshy shrubs with milky juice, leaves alternate below, floral opposite. Flowers as in *Euphorbia*, but involucre zygomorphic, slipper-shaped (in our species), with the florets exserted from the toe, and the heel composed of the saccate base of an outermost superior shorter lobe or "appendage," containing inside at its base 2–6 large tumid glands, rarely glandless. Involucral lobes very unequal, two anterior largest, three dorsal smaller (the appendage is considered as not homologous with a lobe and is exterior to the involucre proper; its morphology seems doubtful), innermost ligulate. Style stout, beak-like, with 3 short 2-toothed lobes.

1. **P. tithymaloides,** *Poit.* Bilaiti-sij, *Vern.*; Adjutant's Hedge; Jew's Slipper.

A fleshy shrub or undershrub with many erect stems, usually about 3 ft. high, but sometimes much larger, bearing numerous more or less elliptic leaves and red or orange slipper-shaped involucres in dichotomous cymes with caducous bracts.

Very common in gardens and hedges. There is a variegated form with white on the leaves. Native of tropical America.

FAM. 30. CALLITRICHACEÆ.

Small weak terrestrial, amphibious or aquatic herbs, with opposite or sub-verticillate (when floating), narrow entire 3-nerved leaves. Hairs sometimes stellate. Flowers monœcious, reduced to a single stamen in the male and a single naked ovary in the female, usually solitary, axillary, supported by two bracteoles at right angles to the leaf, sometimes a single male sub-tended by the bracteoles and an outer female in the same axil, *but without bracteoles.* Filament slender, anther 2-celled, with lateral dehiscence. Ovary of two carpels, each divided by a partition to form a 4-celled compressed 4-lobed ovary, with 2 simple, subulate, stigmatose styles. Ovules 1 in each cell, pendulous, anatropous, with ventral raphe and only one integument. Fruit 4-lobed, splitting into 4 cocci or drupels. Seeds with thin testa and fleshy albumen. Embryo central terete.

Only one genus.

1. CALLITRICHE, *L.*

1. **C. stagnalis,** *Scop.*

A small water-weed with the upper leaves forming a floating rosette, obovate-spathulate, ·5–·75″ long. The minute yellow anthers can often be detected with the naked eye from the axils of the rosette of leaves, the female flowers are usually submerged, at least in fruit. Fruit sub-orbicular with acute keeled but scarcely winged lobes.

Sirguja plateau, 2000 ft., in still water near a stream, *Wood.*

FAM. 31. LINACEÆ.

Herbs or shrubs with alternate simple usually entire leaves. Stipules sometimes intrapetiolar or 0. Flowers 2-sexual. Sepals 4-5, free or connate below. Petals contorted or rarely imbricate. Stamens diplostemonous, the alternate ones sometimes reduced to minute staminodes, filaments united at the base into a hypogynous or somewhat perigynous ring, anthers versatile. Glands 5 or 0, usually adnate to the staminal ring, sometimes 2-lobed. Ovary 3-5-celled, not lobed; styles 3-5, sometimes connate below. Ovules 1-2 axile, anatropous. Fruit 3-5-coccous, or drupaceous. Albumen fleshy or 0. Embryo nearly as long as the seed, straight, rarely incurved, cotyledons broad, radicle superior.

Herbs. Perfect stamens 5. Styles 5 . . . . 1. *Linum.*
Undershrubs. Perfect stamens 5. Styles 3-4 . . . . . 2. *Reinwardtia.*
Shrubs. Perfect stamens 10. Styles 5 . . . . 3. *Hugonia.*
Cultivated shrub. Perfect stamens 10-12. Styles 3-4 . . . 4. *Erythroxylon.*

1. LINUM, *L.* Flax.

Herbs with narrow entire leaves. Stipules 0 or glandular. Stamens 5, perfect, staminodes minute. Disc of 5 glands. Ovary 5-celled, the cells sometimes divided into 2. Styles free. Cocci 5, 1- or partially 2-celled, 2-seeded.

1. **L. usitatissimum,** *L.* Unchi, *K.*; Tisi, alsi, *H.*; Tisi, Mosina, *Beng.*; Pesu, *Or.*; The Flax or Linseed.

An annual 1-2 ft. high with stem simple below, linear or lanceolate leaves, 3-nerved at base and blue flowers, ·7-1″ diam. Capsule about as long as the acuminate sepals.

Extensively cultivated and forming fields of a beautiful blue when in full flower. In all the districts. Fls., Fr. c.s.

It is grown for its seed only, the flax not being manufactured. A pint of raw linseed oil with an ounce each of laudanum and spirits of turpentine is one of the best remedies for colic in ponies.

2. REINWARDTIA, *Dumost.*

Undershrubs with entire or crenate leaves and minute subulate caducous stipules. Flowers yellow in cymose fascicles. Stamens 5 perfect, hypogynous, connate below, with intermediate subulate staminodes. Glands 2-3. Ovary 3-4-celled, cells 2-locellate, styles 3.

1. **R. trigyna,** *Planch* (inc. R. tetragyna, *Planch*). Langora, *Vern.*

A very pretty small shrub, 2-4 ft. high, with green herbaceous branches, ovate-oblong to elliptic-lanceolate, entire or crenate-serrate leaves, and bright yellow or chrome-yellow flowers, 1-1·5″ diam., on numerous small axillary branchlets, rarely solitary or in terminal cymes.

On shady banks and ravines. N. Champaran! Gaya! Chota Nagpur! Angul! Probably therefore in all districts. Fls. Oct.-Feb. Fr. Feb.-March. Perennial, evergreen.

Branches sometimes woody, erect or prostrate and rooting, glabrous. L. up to 3-4″ rarely sometimes with minute teeth, mucronate, narrowed into the slender ·5-1″ petiole. Sepals erect. Petals obovate. Styles 3 (*R. trigyna*) or 4-5 (*R. tetragyna*). Capsule ·3″ diam., depressed globose, with alternate green and orange bands in some states.

Is well worth a place in the garden.

3. HUGONIA, *L.*

Leaves stipulate. Flowers yellow, the lower peduncles converted into spiral hooks. Stamens 10, hypogynous, with glandular swellings on the ring between the filaments. Ovary 5-celled, styles 5, filiform. Ovules 2, collateral in each cell. Drupe globose. Seeds compressed, albuminous. Cotyledons flat.

1. **H. mystax,** *L.* Chulijinka, *Or.*

A sarmentose or climbing shrub, of which the short branchlets bear opposite circinate tendrils (modified peduncles) below the clusters of obovate-elliptic, entire leaves which are 1·5–3″ long, or less on the flowering branchlets. Flowers 1–1·5″ diam., yellow. Drupe yellow, orange or red, ·5″–·6″ diam.

Scrub jungles of Puri Dist. frequent. Fls. May–Aug. Fr. Sept.–Nov.

Young parts yellow tomentose. L. usually rounded at apex (obtuse or subacute, *F.B.I.*), young with a few yellow hairs on mid-rib. Sec. n. fine spreading, very reticulate between. Peti. very short. Stipules subulate, ·2″. Sep. ovate-lanceolate, tomentose, ·25″. St. 5 long and 5 shorter, exserted.

4. ERYTHROXYLON, *L.*

E. coca, Lamk., has been grown on the Ranchi plateau for the drug cocaine derived from its leaves, but without much success commercially. It is a native of the Andes and Peru.

E. monogynum, Roxb., might possibly be found in Kalahandi. It is a bright-green shrub with cuneate-obovate leaves and red edible drupes.

FAM. 32. MALPIGHIACEÆ.

(In the Indian Genera.) Climbing or sub-erect shrubs with opposite entire leaves. Stipules small or 0. Flowers moderate-sized or rather small, regular or irregular, with articulate pedicels, racemed or panicled, 2-sexual. Sepals 5, more or less connate below, one or more sometimes furnished with a large gland. Petals 5, imbricate. Disc obscure. Stamens 10, hypogynous or sub-perigynous, one or more sometimes larger than the others, filaments sometimes connate below. Ovary 3-celled, sometimes angled, with 1–3 straight or coiled styles. Ovule 1 in each cell, axile, pendulous, with ventral raphe and superior micropyle. Fruit of 1–3 winged samaras. Seed exalbuminous, embryo straight or curved.

It is a large American family and several pretty exotic erect shrubs (***Malpighia***, ***Galphimia***, *etc.*) are grown in Indian gardens. These have often small and toothed leaves and the fruit without wings.

Sub-erect or scandent. Fls. m.s., irregular . . . . . . 1. ***Hiptage.***
Scandent. Fls. rather small, regular . . . . 2. ***Aspidopterys.***

1. HIPTAGE, *Gaert.*

Stout climbing or sub-erect shrubs with coriaceous leaves and sometimes intramarginal glands. Stipules 0. Flowers in simple or branched racemes, irregular. Calyx with large glands adnate to the pedicel. Petals unequal and one differently coloured, clawed. Stamens declinate, unequal, filaments connate at base. Ovary 3-lobed. Styles 1–2 coiled and 2–1 rudimentary. Fruit of 1–3 samaras. Seed subglobose. Cotyledons thick, unequal.

1. **H. madablota,** *Gaert.* Sang Karla, *S.*; Madubluta, *Beng.*; Boromali, Nata Nageswar (fide *Grieve*), *Or.*

A large woody shrub, sometimes climbing to a considerable height, with pale branches, elliptic or ovate-oblong or oblong-lanceolate, shortly acuminate leaves, 4–7″ by 2·5″, and showy white flowers ·75–1″ across, with one yellow petal. Each carpel with one large, central, erect, oblanceolate wing, 1·5–2″ long, and two smaller lateral wings.

Chiefly along nalas and ravines. Singbhum and Porahat! Hazaribagh and Gaya Ghats! Santal P.! Mayurbhanj! Narsinghpur! Angul, frequent! Kalahandi, *Grieve*.

Fls. Feb.-March. Fr. April-May. Evergreen.

Young branches and leaves tomentose but soon glabrescent and mature leaves shining, penninerved, with 4–6 arched sec. n. and numerous very faint intermediate ones, base of leaf obtuse. Petiole ·25″. Racemes pubescent, sometimes in leafy panicles. Petals fimbriate.

2. ASPIDOPTERYS, *A. Juss.*

Tall climbing, often slender shrubs with opposite entire leaves, stipules small or 0. Flowers small, in axillary or terminal panicles, pedicels articulate, often minutely 2-bracteolate. Calyx short, eglandular. Petals sessile, entire. Stamens 10. Ovary 3-locular, loculi flattened at the back and laterally winged, these wings largely developing in fruit which consists of 3 (–1) samaras, nucleus sometimes with an additional small dorsal wing. Styles 3.

L. sometimes glabrescent. Samara narrow oblong . . . . 1. *indica.*
L. densely silky beneath. Samara broadly elliptic . . . . 2. *Hutchinsoni.*

1. **A. indica,** *Hochreut.* Syn. A. Roxburghiana, *A. Juss.*

Climber, with broadly ovate or elliptic shortly acuminate ovate shining leaves, glabrous or silky beneath, mostly 4–5″, with acute to rounded but not cordate base. Flowers small, white, on slender articulate pedicels, in large axillary and terminal effuse panicles, and samaroid fruit with elliptic-oblong or linear-oblong wings 1·5–2·3″ long.

Orissa, frequent, Puri and Angul! Fls. Sept.-Oct. Fr. Jan.-Feb.

Stems attain 4″ diam. Branches with deciduous rusty hairs. L. (in some Angul specimens) attain 8″ by 5·5″ with usually rounded often oblique base and short curved acumen, larger sec. n. only 3–4, of which 2 are usually near the base and very oblique, intermediate sec. n. fine spreading, marginal nerve strong. Petiole ·6–1″ or sometimes 1·4″. Lower branches of panicle (from leaf axils) up to 8″ long, rusty pubescent, secondary branches usually sub-verticillate with the flowers racemed and subcorymbose. Pedicels capillary ·3–·4″. Petals reflexed ·12″ long. St. exserted. There are two varieties.

Var. α Leaves thinly fulvous silky beneath even in fruit. Samara linear-oblong, attaining 2″ by ·5″. Pedicels above the articulation and calyx conspicuously pubescent. Mals of Puri.

Var. β. Leaves glabrescent. Samara much broader in the middle (ell. oblong) attaining 2·3″ by ·8″. Pedicels above the articulation, glabrous. Calyx minutely puberulous and ciliate. Puri and Angul.

NOTE.—Var α is evidently *A. indica*, Hochreut. (*Kew Bulletin*, No. 3, 1917, Revision of *Aspidopterys*), but var. β appears to connect the species with *A. floribunda*, Hutchinson, except that the calyx is not quite glabrous.

The shape of the samara in a long suite of specimens appears rather variable.

2. **A. Hutchinsoni,** *Haines. Kew Bulletin,* No. 2, 1920.

A stout climber with sub-woody branches rough with the bases of fallen hairs. Twigs tomentosely hairy. Leaves rather coriaceous, orbicular-obovate or orbicular, suddenly cuspidate, 3–4″ long, base straight or rounded, densely silkily hairy beneath. Panicles short, lateral. Samaras broadly elliptic, 1″ by nearly 1″, nucleus also with a median wing ·5″ long.

Mayurbhanj, elev. 3000 ft.! Fls. Dec.-Feb. Fr. May-June.

L. sometimes broader than long, mostly 4 by 3·5″, densely yellow tomentose both sides when young, glabrescent above, sec. n. about 5, of which one is usually from the base, tertiaries raised beneath. Petiole ·75″, pubescent. Panicles brown hairy. Pedicels short articulate near the base and glabrous (in fruit) above the articulation. Sep. dorsally hairy. Pet. oblong, ·18″ long. Samaras membranous, retuse at the apex. Dorsal wing semi-ovate or semi-lanceolate ·15″ broad. Carpophore 3 mm. long, puberulous.

FAM. 33. ZYGOPHYLLACEÆ.

Shrubs, undershrubs or herbs, rarely small trees, usually with opposite, pari-pinnate leaves, rarely alternate (*Peganum*) or simple or odd pinnate; stipulate. Flowers solitary or in scorpioid cymes or contracted racemes, often appearing axillary or extra-axillary (in *Guaicum* appearing umbellate), regular. Sepals 5, rarely 4, free or united at base, imbricate, rarely valvate. Petals, as in the sepals, rarely 0. Stamens diplostemonous, rarely 3 times as many as petals, filaments usually appendaged at base with a scale, anthers versatile. Ovary 4-5-, seldom 2–12-celled, usually angled or winged, with 1-several axile pendulous ovules. Style angled or furrowed, stigma simple, rarely 5. Fruit usually capsular, or of cocci more rarely baccate or drupaceous. Albumen present or 0. Embryo as long as the seed, straight, rarely curved; cotyledons thick or flat; radicle straight, superior.

Prostrate herbs with pari-pinnate leaves . . . . 1. *Tribulus.*
Erect herb with deeply irregularly cut leaves . . . . . . 2. *Peganum.*
Small grey green tree or shrub with 2-foliolate leaves. Fruit drupaceous . . . . 3. *Balanites.*
Small cultivated tree with blue flowers . . . . *Guaicum*, p. 154.

1. TRIBULUS, *L.*

Prostrate herbs with opposite pari-pinnate leaves and white or yellow small flowers appearing axillary or pseudo-axillary (the branching is really cymose). Petals 5, fugacious. Disc annular, 10-lobed. Epipetalous stamens longer, alternate shorter with a small gland at base. Ovary hirsute, 5–12-celled and -lobed, Fruit of 5–12 winged or spinous or tuberculate indehiscent cocci.

1. **T. terrestris,** *L.* Gokhru, Goksura, *Beng., H.*; Caltrops, *Eng.*

Densely hairy, with prostrate branches, 1–2 ft. long. Leaves 2–3″ long, often unequal in a pair, leaflets 4–7 pairs, oblong with oblique base, mucronate, ·3–·8″. Flowers pale yellowish, ·3–·6″ diam., on peduncles ·4–·5″. Fruit usually hairy, cocci each with 2 very sharp rigid spines and 2 shorter ones.

Common roadsides and pastures, especially in sandy soil, throughout the area.
Fls., Fr., h.s. and r.s., perhaps all the year round.

Some specimens outside our area show flowers over 1″ diam. A form collected by me near Chandpur on the sands near the sea (Balasore Dist.) had snow-white tomentose leaves, leaflets only ·1–·2″ and small flowers. The species, if really one, has a wonderful range extending from the plains to the Tibetan tableland, 11,000 ft., and to Australia and Africa!

Bicycle tyres are certain to be punctured if wheeled over grass where this weed occurs. The entire plant and especially the dried fruits are used in Hindu medicine. Water is rendered mucilaginous by it and is drunk especially in diseases of the genito-urinary system.

2. PEGANUM, *L.*

Perennial herbs, with alternate entire or multifid leaves with setaceous stipules. Flowers leaf-opposed, white. Sepals often foliaceous and pinnatifid, persistent. Stamens 12–15, in two whorls, the outer with twice as many as the inner, filaments dilated below. Ovary deeply 2–3-lobed. Fruit 3–4-celled, 3-valved or indehiscent.

1. **P. harmala,** *L.* Harmal, *H.*; Isband, *Beng.*; Syrian Rue.

Rather a pretty bush, 1–3 ft. high, densely dichotomously corymbosely branched and with the leaves cut into linear segments about 1″ long. Flowers white, ·5″ long, on leaf-opposed peduncles. Sepals linear, exceeding the petals. Stamens 12–15. Capsule globose, ·4″ diam.

Fairly frequent in the U.P. and Punjab and occasionally entering the province from the north-west.
Fls., Fr. April.

The seeds yield a red dye and are used in medicine. They contain alkaloids.

Guaicum officinale, *L.*, is a small tree with dark glossy pinnate leaves and the branchlets terminated by pseudo-whorls (through the abbreviation of the axes of the cyme) of blue flowers. It is one of the most beautiful and ornamental trees in flower and deserves to be far more widely cultivated than it is.

3. BALANITES, *Delile.*

Thorny small tree or shrub, with alternate leaves consisting of one pair of coriaceous leaflets. Flowers yellowish green, in contracted cymes or pseudo-umbels. Sepals 5, concave. Petals 5, imbricate. Stamens 10, inserted on the somewhat elongate torus at the base of the prominent disc which is 10-lobed below, filaments subulate. Ovary 5-celled, or by suppression 1-celled, slightly sunk in the disc with 1 pendulous ovule in each cell. Fruit drupaceous with a very hard 5-angled, 1-celled and 1-seeded stone.

1. **B. Roxburghii,** *Planch.* Hingua, *H.*; Ingun, *Kharw.*

A small grey-green tree or low bush, copiously armed with axillary or extra-axillary thorns, hoary-tomentose all over with 2-foliolate leaves and green and yellow flowers ·3″ diam. Drupe oval, 1·5–2″ long, slightly 5-grooved both ends.

Common in Palamau on the east bank of the Son and frequent near Kechki! Hazaribagh, waste lands and low scrub jungle! Gaya, frequent! Fls. Nov., also Feb.–May. Fr. Nov.–Dec.

Thorns stout, often elongate and bearing leaves. Lflts. entire elliptic, obovate or oblanceolate, ·75–1·25″, petiole hardly any. Petals strap-shaped or oblanceolate villous above, yellow, loosely imbricate in bud. Style subulate, stout 5-grooved. Drupe yellow, full of oil and with a very offensive smell.

FAM. 34. GERANIACEÆ.

Herbs, undershrubs or rarely trees, with opposite or alternate, simple or compound, stipulate, often palminerved, leaves. Flowers umbelled, cymose or racemose, small or showy, regular or nearly so. Sepals 5, free, imbricate, or connate below. Petals 5, usually alternating with 5 glands. Stamens as many or 2–3-times as many as the petals, connate into a ring at their base or free, the outermost opposite the petals. Ovary 3–5-lobed or -celled, with 1–2 or 2–many ovules in each cell usually pendulous with micropyle upwards. Fruit capsular or splitting into beaked cocci which separate from the central axis or (in *Averrhoa*) baccate. Embryo often green, straight or curved in albumen.

1. Herbs. Fruit capsular or of cocci.
   Leaves simple, often lobed. Petals alternating with glands . 1. *Geranium.*
   Leaves pinnate. Glands 0 . . . . 2. *Biophytum.*
   Leaves 3-foliolate. Glands 0 . . . . 3. *Oxalis.*
2. Trees. Leaves pinnate. Fruit baccate . . . . 4. *Averrhoa.*

The common garden "*geranium*" belongs to the genus *Pelargonium*. The flowers are more or less irregular and a peculiar tube-like spur will be found under the uppermost sepal adnate to the pedicel; there are no disc glands and only 2–7 of the stamens bear anthers.

The garden "*nasturtium*" belongs to the genus *Tropæolum*, often put into a separate family (*Tropæolaceæ*), distinguished by the long hollow free spur on the posterior sepal, 8 stamens and 3-celled ovary splitting into 3 cocci in fruit. The genus *Nasturtium* belongs to the family *Cruciferæ*.

1. GERANIUM, *L.*

Leaves palmately-lobed, rarely entire. Flowers on 1–2-flowered peduncles. Stamens 10, all with anthers. Fruit beaked, breaking up into 5 cocci with elastically coiling ends which remain for a time suspended to the tip of the central axis of the fruit.

1. **G. ocellatum,** *Camb.* Purple-eyed Geranium.

A small herb with a short rather woody stem, often clothed with the persistent leaf stipules, tufted long-petioled orbicular palmately 4–7-lobed leaves, 1–1·5″ (rarely 2″) diam., and numerous axillary few-flowered peduncles of rose-coloured flowers, ·5–·75″ diam., with a purple eye.

Parasnath 4000 ft.! Neterhat (Palamau) 3300 ft.! Fls. Oct.–Dec. and sometimes up to March. Fr. Dec.–April.

Compact and tufted with very short peduncles among the crowded radical leaves or with long, slender, few-leaved flowering stems which attain 10″ long. L. cut about three-fourths of the way down into obovate or cuneate lobes, lobes 3–5-lobulate and lobules with few teeth, both sides hairy. Petioles 2–4″, hairy. Peduncles among the radical leaves usually very short and 1–2-fld. with short pedicels, those on the stems either short and sub-umbellate, or sometimes very slender and up to 3″ long, with pedicels up to 1·5″ long! Bracts lanceolate, hairy, ·1–·2″. Buds ovoid. Sep. ·17″, hairy and glandular lanceolate or ovate-acuminate strongly 3-nerved with the central nerve produced into a long mucro, base rounded. Fruiting pedicels deflexed and fruiting calyx ·2″ long. Ripe carpels transversely corrugate.

2. BIOPHYTUM, *DC.*

Herbs often small and sometimes like miniature trees, with a single stem and crown of leaves. Leaves pari-pinnate, leaflets opposite,

petiole swollen at base. Flowers small, yellow umbelled on terminal peduncles. Stamens 10, free, 5 outer smaller. Styles 5. Fruit a loculicidal capsule.

Flowers dimorphous as regards relative length of style and stamens. The leaflets are sensitive and close at nights.

Stem often short. Sepals longer than pedicels and fruit.
Lflts. 8-14 prs., pedicels distinct . . . . 1. *sensitivum.*
Lflts. 5-7 prs., fls. sessile or nearly so . . . . 2. *apodiscias.*
Stem usually long and graceful. Sepals shorter than the pedicels 3. *Reinwardtii.*

1. B. sensitivum, *DC.* Lak chana, *H.*

A pretty little herb with leaves and peduncles rising direct from a stout stock or crowning a hairy sometimes branched stem 3–4″ high. Leaves 1·5–5″ long, with terminal leaflets ·3–·5″ long, decreasing in size downwards, sessile, oblong or oblong-obovate, rhachis usually hairy. Peduncles often exceeding the leaves, densely hairy with numerous, chaffy, nerved bracts and small yellow flowers on short pedicels. Sepals lanceolate, ·2″ long, like the bracts and exceeding the pedicels. Capsule ellipsoid, 5-grooved.

Common Chota Nagpur! Puri! Probably throughout the area. Fls., Fr. r.s. It is given to children to induce sleep by the Kols and Santals. A case of the Law of Signatures!

2. B. apodiscias, *Turcz.*

A very small delicate species, 1–3″ high, leaves ·5–1″ long only, with only 5–7 pairs of strongly nerved leaflets and inflorescence nearly sessile. The seeds are said to have scattered tubercles, while those of *B. sensitivum* have transverse tubercled ridges.

Monghyr, *Hamilton.*
Stems rarely 3″ sometimes 0, hairy above. Peduncles 0 or very short. Pedicels ·1–·15″, sepals ·2″, about as long as the rather acute capsule. It is not the pedicels, as sometimes stated, but the peduncles that are so short in this species.

3. B. Reinwardtii, *Walp.*

A graceful little herb with its crown of pinnate leaves always terminating a slender stem 2·5–10″ high. Leaves 2–3″ with usually 8–12 pairs of leaflets, which decrease in size very rapidly towards the base, so that the uppermost are ·4–·5″ and the lowest are often only ·1″ long, rhachis usually hairy, often pink. Peduncles shorter or longer than the leaves, pubescent; crown of chaffy bracts shorter than the pedicels, which again are longer than the ·1″ long sepals. Sepals equal or somewhat longer than the capsule.

Rocky jungles and damp banks. Hills of Chota Nagpur, common. Fls., Fr. r.s. and c.s.

3. OXALIS, *L.* Wood Sorrel.

Herbs with often bulbous or tuberous roots and acid juice. Leaves digitately 3-foliolate. Flowers variously coloured, on axillary 1-more flowered peduncles. Disc without glands. Stamens 10, all antheriferous, free or slightly connate at base. Fruit a loculicidal capsule with 5 persistent valves.

The leaflets are articulate on the petiole and close at night.

1. **O. corniculata,** *L.* Amboti, Chalmori, *H.*; Amrul, *Beng.*; Tandi chatom arak', *S.*; Yellow Sorrel.

Stems diffuse with procumbent branches, leaflets obcordate, stipules oblong, united to the base of the petioles, peduncles about 2-flowered, shorter than the leaves, pedicels reflexed in fruit. Flowers yellow, ·4-·5″ diam. Capsules narrowly oblong.

A common weed in gardens, etc., in all districts. It extends into England. Fls., Fr. all the year.

The leaves are used as a pot-herb.

4. AVERRHOA, *L.*

Trees with alternate exstipulate imparipinnate leaves and opposite or alternate leaflets. Flowers regular in panicled cymes, often from the old wood. Sepals 5, imbricate. Petals 5, twisted or occasionally imbricate. Glands 0. Stamens 10, all perfect, or 5 staminodes, united at the base. Ovary 5-lobed and -celled, each lobe with a short style and capitate stigma. Ovules many. Fruit baccate, 5-ridged or -lobed. Seeds sometimes arilled, albumen scanty. Embryo straight.

1. **A. carambola,** *L.* Kamaranga, *H.*, *Or.*; Karmal, Kamarak, *Beng.*

A small tree with somewhat smooth bark and dense dark crown. Leaflets 7–11, broadly-oblong, ovate, elliptic or elliptic-lanceolate, obtuse to acuminate, basal often only ·7″, upper often 4″ by 2″. Flowers campanulate, ·2–·25″ long and broad, pretty, pink with deeper pink throat, in panicles from the branches or axillary or terminal. Fruit 3″ long, yellowish, sharply 5-angled.

Planted to a small extent in most stations! Fls. June-Sept. Fr. Sept.-Oct. Evergreen.

Attains 3 ft. girth. Leaflets puberulous beneath, base usually very oblique. Seeds with a 2-lobed lacerate aril. Leaves said to be irritable to touch. Fruit eaten, usually stewed with sugar.

2. **A. bilimbi,** *L.* Bilimbi, *Vern.*

Easily distinguished by the more numerous narrow-oblong or linear-lanceolate acuminate leaflets more pubescent beneath. Fruit with rounded lobes and exarillate seeds. A graceful little tree, occasionally planted. The acid fruits are, like the last, supposed to promote digestion. The juice is made into a cooling drink and also used to remove stains from clothes.

FAM. 35. BALSAMINACEÆ.

Herbs with opposite alternate or whorled, simple exstipulate penninerved leaves, and axillary, rarely pseudo-terminal, solitary or racemed, usually brilliantly coloured flowers. Flowers ebracteate, zygomorphic. Sepals 3, rarely 5, imbricate, the large posterior (standard) variously shaped, differing from the others, petaloid and always spurred. Petals 5, or, through fusion of two pairs, 3, variously shaped. Stamens with short broad filaments and connate anthers which are hooded over the stigma. Ovary 5-celled with 3–more pendulous axile ovules in each cell, raphe dorsal. Fruit a succulent

capsule elastically opening upwards by 5 valves (or in *Hydrocera* baccate). Albumen 0.

1. IMPATIENS, *L.*

Characters as above.

1. **I. balsamina,** *L.* Gul-mendi, *H.*; Dupati, *Beng.*; Haragaura, *Or.*; Common Balsam.

An annual with alternate rather distant leaves, narrow-lanceolate acuminate, deeply serrate, with glandular petiole. Flowers purple or rose coloured, solitary or fascicled, lateral sepals broad, ovate, minute, standard orbicular retuse, wing petals very broad, lip small, spur short or long, incurved. Capsule tomentose.

Common in waste ground in the rains, but usually near villages. Fls., Fr. r.s. The origin of the common garden balsam.

FAM. 36. RUTACEÆ.

Trees or shrubs, rarely herbs, abounding in pellucid glands filled with essential oil, with opposite or alternate, simple or compound exstipulate leaves. Flowers regular in cymes or panicles, often polygamous. Calyx of 4–5 sepals usually connate below. Petals 4–5, rarely fewer (or more in some *Aurantieæ*), valvate or imbricate. Stamens hypogynous, diplostemonous or numerous, filaments free or somewhat connate, inserted around a crenate or lobed, sometimes elongate disc. Anthers introrse. Ovary entire or lobed, 4–5-celled (1-celled in *Feronia*) or more-celled (many *Aurantieæ*). Styles as many as carpels or united with terminal stigma. Ovules usually 2, sometimes numerous in each cell. Fruit baccate, drupaceous or capsular, sometimes splitting into cocci. Seeds often solitary in the cells. Albumen fleshy or 0. Embryo straight or curved, radicle superior.

Chloroxylon is sometimes included in this family on account of its gland-dotted leaves, but its numerous ovules and its fruit are more those of *Meliaceæ*, tribe *Cedreleæ*, which connects the two families.

Tribe *Aurantieæ* (genera 5-15) is best characterised by its exalbuminous seeds—an awkward field character not here used.

The thorns are often found laterally to a leaf or fascicle of leaves. In the axil there arises 1–3 buds. Frequently one of these develops into a thorn; sometimes the two lateral develop as thorns, in other cases one lateral bud develops as a thorn and the other as a branch bearing one or a fascicle of leaves. When the original subtending leaf falls the thorn thus becomes lateral to a leaf or fascicle.

I. Ovules 2–1 in each cell.
  A. L. pinnate. Ovary 2–5-lobed. Fruit a capsule.
    Leaves opposite. Unarmed . . . . 1. *Evodia.*
    Leaves alternate. Usually prickly . . . . . 2. *Zanthoxylum.*
  B. L. digitately 3-foliolate. Branches prickly . . . 3. *Toddalia.*
  C. L. 1-foliolate. Fruit dry or baccate :—
    a. Unarmed. Flowers in long peduncled corymbs . . 4. *Acronychia.*
    b. Usually with axillary thorns. Fls. axillary.
      Fls. small fascicled or shortly racemose . . . . 5. *Atalantia.*
      Fls. large, 1″ long . . . . 6. *Paramignya.*
  D. L. pinnately 3-foliolate. Ovary entire. Fruit baccate.
    Leaves sessile . . . . 7. *Triphasia.*
    Leaves with winged petioles . . . . 8. *Limonia.*

E. L. pinnate (rarely also 3-1-foliolate mixed in *Glycosmis*). Ovary entire. Fruit baccate.
- *a.* Thorny. Petioles winged . . . . 8. *Limonia.*
- *b.* Unarmed. Petioles not winged.
  1. Style short persistent. Fls. small in narrow panicles 9. *Glycosmis.*
  2. Style articulate, deciduous.
     - Petals valvate. Fls. in large terminal corymbs . . 10. *Micromelum.*
     - Petals imbricate. Filaments linear-subulate . . 11. *Murraya.*
     - Petals imbricate. Filaments dilated below . . 12. *Clausena.*

II. Ovules many in each cell.
- L. 1-foliolate . . . . 13. *Citrus.*
- L. 3-foliolate . . . . 14. *Ægle.*
- L. pinnate. Ovary 1-celled . . . . 15. *Feronia.*

1. EVODIA, *Forst.*

Trees or shrubs with opposite simple 3-foliolate or imparipinnate leaves with entire leaflets. Flowers small in panicled cymes, 4-5-merous. Petals without claws, valvate or slightly imbricate. Stamens inserted at base of the disc, filaments subulate, anthers oblong. Ovary deeply, usually 4- rarely 5-lobed and -celled. Style from between the lobes. Ovules 2 in each cell, collateral or superposed. Fruit of 4 (or 5) coriaceous, 1-seeded dehiscent carpels with separable horny endocarp. Seeds with hard shining testa, sometimes extruded from the carpel, hilum linear. Embryo straight with ovate or oval cotyledons.

1. **E. meliæfolia,** *Benth.* Ankhijhora, *Or.*

A large tree with grey bark, marked on the branches with very large prominent lenticels. Leaves imparipinnate with 9 to 17 lanceolate or oblong-lanceolate acuminate leaflets, 3·5–6″ long, opposite or sub-opposite. Flowers in terminal panicles as broad as long. Fruit deeply 4–5-lobed, ·3–·4″ diam., each carpel with a shining black oval-oblong seed ·12″, extruded on the persistent placenta.

Bonai, Cooper! Fls. May–July? Fr. Sept.–Oct.

Distrib.—Eastern Himalayas (ascending to 6000 ft. in Sikkim and Bhutan) Assam and Upper Burma.

Bark rough (*Cooper*). L. rhachis 8–14″, pubescent. Lflts. mostly opposite, lower sometimes alt. and smaller, more or less permanently pubescent on the midrib. Sec. n. spreading 15–20 fine, glands very minute and indistinct or scarcely visible. Petiolule ·1″. Panicles terminal (sometimes also axillary), 4–6″ diam., brachiate pubescent. Fls. white. Pet. oblong ·17″. St. exserted. Placentas from the inner basal angle of the carpel broad, membranous and extruded in fruit. Ovules collateral. Carpels usually 4, very aromatic with large glands in the epicarp. Testa very thick. Albumen scanty fleshy. Cotyledons fleshy, veinless, broadly oval with short blunt radicle.

2. ZANTHOXYLUM, *L.*

Trees or shrubs usually armed with stout prickles. Leaves alternate, 3-foliolate or imparipinnate with opposite or alternate entire or crenate, often very oblique leaflets. Flowers small, in axillary or terminal peduncled cymes. Calyx 3–8-fid or 0. Petals 3–5 rarely 0, imbricate or induplicate-valvate. Disc small or obscure. Stamens 3–5, hypogynous or reduced to scales in female flowers. Ovary of 1–5 oblique 1-celled carpels. Styles sub-lateral. Ovules 2

in each cell, usually collateral. Fruit of 1–5 globose, coriaceous, or fleshy 1-seeded carpels dehiscing ventrally, endocarp horny, separating or not. Seed oblong and compressed or globose, often extruded from the carpel, hilum broad, testa bony or crustaceous, blue or black shining, albumen fleshy; embryo axile, straight or curved, cotyledons flat, radicle very short.

Petiole winged, flowers apetalous . . . . 1. *acanthopodium*.
Petiole not winged, flowers polypetalous.
  Lflts. crenate, with a large gland in each crenature . . . 2. *budrunga*.
  Lflts. entire, very unequal-sided . . . . Var. *rhetsa*.

1. **Z. acanthopodium,** *DC.* Var. timbor, *J.D.H.* (Wall. Cat. 7116).

A short or small tree with dense foliage and prickly trunk and branches, branches with dense rusty tomentum. Leaflets 2–6 pairs, lanceolate, petiole and rhachis narrowly winged, cymes very short, dense, ·5–1″.

Shahabad? Recorded by *Hamilton* from the "Chainpur hills," which are supposed to be those in Shahabad, but there is some doubt in the matter.

2. **Z. budrunga,** *Wall.* Syn. Z. Rhetsa, *DC.*; Fagara Budrunga, *Roxb.*; Morai, *Or.*

A small or moderate-sized tree with pale corky bark, covered with conical prickles on stems and branches and sometimes a few small ones on the leaf rhachis. Leaves clustered towards the ends of the stout branchlets, 18″–2 ft. long (with the petiole). Leaflets 19–25 or fewer, somewhat like those of a Toon, 3–6″ long, oblong or lanceolate, caudate, entire or crenate, when crenate with a large gland in the sinus. Flowers ·17″ diam., yellow, 4-merous, in large terminal panicles with opposite branches.

Ranchi Ghats (Bishanpur, along nalas)! Puri, common! Fls. March–June. Fr. r.s. Deciduous. New leaves appear June.

Bark corky. Pith large septate. Young prickles upcurved. Lflts. very oblique at base, rounded on the upper side, with the lamina shorter, narrower and acute on the petiole on the lower side; some Puri specimens, however, have leaflets with a more regular lamina. Rhachis in Puri specimens unarmed and leaflets less crenate, often entire. Panicles sometimes 18″. Pet. valvate. Ripe carpels solitary, ·25″ diam., tubercled. Seed blue-black, tasting of black-pepper.

I think it is impossible to separate *Z. budrunga* and *Z. rhetsa*. The former is usually the north India form, the latter usually the Peninsular form, and, as might be expected, the Bihar and Orissa plant unites the two, that from Bishanpur being more nearly *Z. budrunga* and that from Puri more nearly *Z. rhetsa*, but even in the latter some leaflets are crenate. Again, some Sikkim and Chittagong specimens occur with entire leaves and several have been doubtfully named in the *Calcutta Herbarium*. Moreover, the characters used by *Roxburgh* to discriminate the two species are *not* the leaf crenatures, and both his descriptions and figures show the leaves of both species quite entire! He evidently knew his "Fagara Rhetsa" well, but seems to have had a specimen of *F. budrunga* with very few leaflets.

3. TODDALIA, *Juss.*

1. **T. aculeata,** *Pers.* Syn. T. asiatica, *Lamk*; Tundpora, Tundupara, *Or.*

A rambling or scandent very prickly shrub with alternate 3-foliolate leaves with sessile leaflets. Flowers small, 1-sexual, in axillary cymes, white or yellowish. Fruit globose, ·25″ diam.,

3-5-grooved and -celled, orange. Seeds 1 in each cell, angled, testa coriaceous. Embryo curved, terete.

In the south of the Province especially near the coast. Balasore! Puri, common, esp. in the scrub jungles! Mayurbhanj, in the hills, common! Fl., Fr. Aug.-Dec.

Lflts. 1-3″, ell., obovate oblong or lanceolate, crenulate, tip obtuse retuse or acute or obtusely acuminate. Fls. ·2″ diam.

Fresh root bark and whole plant pungent and aromatic. The former is used in Hindu medicine and is used in fevers, and is both diaphoretic and antiperiodic. It contains the bitter alkaloid "berberine." Unripe berries pickled and eaten. Vide *I.P. & D.* for other uses.

4. ACRONYCHIA, *Forst.*

Trees or large shrubs with opp. or alt. 1-foliolate entire leaves. Fls. yellow in peduncled corymbs, polygamous. Calyx 4-lobed, imbricate. Pet. 4, spreading and revolute, valvate. St. 8, inserted under a thick 8-angled tomentose disc, fil. subulate, alternate longer. Ovary sunk in the disc, tomentose 3-5-celled; style terminal, stigma 4-grooved; ovules 2 superposed. Fr. a 3-5-celled drupe. Seeds often extruded from the carpels, testa black, albumen copious, embryo straight, cotyledons oblong, flat.

1. **A. laurifolia,** *Blume.*

A small tree with opp. and alt. leaves. Lflt. 3-7″, ell.-oblong obtuse or mostly obtusely acuminate, glabrous, with rather irregular and finely reticulate nervation. Corymbs axillary, 3-5·5″, including the long peduncles. Petals ·2″, linear, bearded at the base within.

Damp jungles. Mals of Puri! Bonai, rather rare, *Cooper*! Fls. June-Aug. Fr. Nov.-Dec. Evergreen.

Bark grey, smooth. Lflt. with about 8 sec. n. fine raised beneath, some uniting in loops and with intermediate nearly as strong, tertiaries very reticulate, marginal strong. Petiole (rhachis) ·5-1″ long, thickened both ends. Fls. fragrant, yellowish-white. Pedicels slender pubescent. Sep. very small rounded persistent, as also is the disc. Fruit ·4″ diam., somewhat obovoid with depressed or apiculate top, 4-sided or grooved, pubescent, very aromatic.

"Wood greyish white, little used. Wt. about 47 lbs." *Gamble.*

5. ATALANTIA, *Correa.*

Thorny or unarmed shrubs or trees with alt. 1-foliolate coriaceous persistent entire or crenulate leaves. Stipule-like scales (undeveloped leaf buds) often present at base of the petioles and spines. Fls. fascicled or in short axillary racemes, corymbs or panicles. Calyx 3-5-lobed or -partite, sometimes irregularly lobed and split. Pet. 3-5, free or adnate to the stamens and united with them into a tube, imbricate. St. 6-8, rarely more, sometimes united into a tube inserted round an annular or cupular disc, subequal or alternate shorter. Anths. short, ovate-oblong or base cordate. Ovary 2- or 4-, rarely 3- or 5-celled. Style deciduous. Ovules 1 or 2 collateral. Berry sub-globose, 1-5-celled and -seeded. Seeds oblong, cotyledons fleshy.

1. **A. monophylla,** *Correa.* Narguni, *Or.*

A large thorny shrub or small tree with quite smooth bark, ovate-ell., ell. or lanceolate entire leaves, 1-3″ by ·5-1·25″, with emarginate

tip and rounded base. Fls. white, in very short axillary or sub-terminal corymbs. Calyx sometimes irregularly split. Fruit ·5″ diam. (1″ *F.B.I.*).

In the south of the province, chiefly on the east coast. Common in Puri! Banki! Sambalpur, as a shrub only, and rare! Fls. Oct.–Dec. Fr. April–May.

Attains 15″ girth. Trunk often with branched thorns. Twigs pubescent, often with short axillary thorns. L. very finely nerved, with about 1–8 sec. n. with fine intermediate and reticulate tertiaries. Petiole ·2–·3″, pubescent. Corymbs sub-sessile, pubescent, rhachis shorter than the ·3–·5″ long pedicels. Calyx subequally or irregularly shallowly 3-5-lobed. Pet. ·25″, adnate at base to the staminal tube. Ovary usually 4-celled narrowly ovoid, the tip only as wide as base of the ·12″ long style. Berry 1–4-seeded.

"Wood yellow, hard close grained." *Gamble*. Recommended by *Kurz* and *Gamble* as a substitute for boxwood.

6. PARAMIGNYA, *Wight*.

Shrubs, often climbing and with axillary thorns. L. 1-foliolate, entire persistent. Fls. rather large, axillary, solitary or fascicled. Calyx cupular or small and 4–8-lobed. Pet. 4–5, free, imbricate or rarely induplicate-valvate. St. 8–12, inserted round a columnar disc, filaments free, anthers linear-oblong. Ovary 3–5-celled. Style elongate, deciduous. Ovules 1 or 2, obliquely superposed. Berry ovoid or sub-globose, 1–5-seeded. Seeds large, oblong, compressed, testa membranous, cotyledons fleshy.

1. **P. Griffithii,** *Hook f.*

A woody climber with thorny bosses on the stem and stout reflexed or recurved axillary thorns. L. oblong-lanceolate or oblong, 3–5·5″, acuminate with rounded base and petiole ·5″ long. Flowers 1–2, axillary, ·7″ diam., white. Berry subglobose, broader than long, circular or elliptic in transverse section, ·8–1·25″ diam., hairy, juice viscous with strong unpleasant smell, the pericarp full of large glands.

Evergreen forest, Mals of Orissa! Fls. Dec.? Fr. April.

Stems attain 6″ girth, bark white, rather corky, blaze brownish. Twigs pubescent. L. softly hairy beneath or at least on midrib; sec. n. 9-12 inconspicuous. Peduncle ·25″. Calyx ·15″ diam., acutely 6-8-toothed. Pet. (not seen in our specimens) linear-oblong, ·3″ long. Ovary hairy, cells 2-ovuled. Berry suddenly contracted at the base into a short stalk above the persistent calyx. Seeds large, oblong, ·5–·7″ long.

2. **P. monophylla,** *Wight*, occurs (*f. Gamble*) in Ganjam and therefore might be found in Orissa. The leaves are nearly always glabrous, obtuse or with short blunt acumen. Calyx ·25–·27″ diam., obtusely-lobed. Pet. 1″ long. Fruit ovoid or obovoid, longer than broad.

7. TRIPHASIA, *Lour.*

1. **T. aurantiola,** *Lour.* Syn. T. trifoliata, *F.B.I.*; Chini narangi, *Vern.*

A handsome glabrous shrub with straight usually paired axillary thorns, 3-foliolate leaves scarcely petioled and ovate or elliptic coriaceous rounded or retuse crenulate leaflets ·5–1·3″ long. Fls. solitary axillary, ·4″ long, white, fragrant, peduncles hardly any. Calyx small pubescent. Petals linear-oblong. Berry ·5″, fleshy.

In gardens only. Fls., Fr. h.s.

8. LIMONIA, *L.*

Shrubs or small trees, usually thorny* with pinnately 3-more-foliolate leaves with winged petioles. Flowers panicled, racemed or fascicled. Stamens 8–10. Ovary oblong, 4-5-celled, with short stout deciduous style. Fruit baccate, 1–4-celled and -seeded, seeds imbedded in mucilage, cotyledons fleshy.

1. **L. acidissima,** *L.* Beli, *H.*; Belsain, *Kharw.*; Bhenta, *Or.*

A small straight tree, attaining 30 ft., with 1–2 axillary thorns,* 5-7 leaflets with winged rhachis, and small white or pale yellowish-white flowers, in very short close racemes. Fruits small, globose, black when ripe and intensely bitter (*not* acid).

In the drier jungles south of the Gangetic plain. Frequent in Palamau (Betlah Forest, etc.)! Santal Parg., in the south! Mayurbhanj! Puri, very common, esp. on the laterite! Athmallik! Angul, Durgupur range! Kalahandi, *Cooper.* Fls. May-June. Fr. ripens Nov.-Dec. Sub-deciduous at the time of flowering. Shoots pubescent. Lflts. opposite ell. or elliptic-ovate crenate, 1–2″ long, with cuneate base and usually obtuse notched apex. Wings narrowly obovate. Racemes ·5-1″, mostly from leafless axils. Fls. ·25″ to (in Mayurbhanj) ·5″ diam., long-pedicelled, 4-merous. Ovary cells 1-ovuled. Fruits ·5″ diam., green till ripe.

It is largely used for cart axles.

9. GLYCOSMIS, *Correa.*

Shrubs or trees. Leaves 1-foliolate or imparipinnate, with alt. or opp. leaflets. Flowers small in axillary, rarely terminal panicles. Calyx 4–5-partite. Sepals small, broad, imbricate. Pet. 4–5 imbricate often glandular. St. 8–10 free, inserted round the disc, filaments linear or subulate, anthers with a dorsal or apical gland. Ovary 2–5-celled, with very short persistent style and simple stigma. Ovules solitary and pendulous. Berry 1–3-seeded. Seeds oblong, testa membranous.

The two following species are connected by intermediates and are united in the *F.B.I.* under G. pentaphylla, *Corr.*, and under G. cochinchinensis, *Pierre*, in the *Flora of Madras*. They are easily distinguished in our area.

Large bush or small tree, lflts. 1–4″, panicle ·5-2″, axillary, pet. lanceolate or oblanceolate, ·22″, filaments terete, gradually attenuate, ·12″ . . . . 1. *arborea.*
Shrub 2-4 ft., lflts. 2–5″, panicles 1·5-3″, often terminal, pet. obovate, ·18″, filaments flattened with suddenly acute tip, ·08″ 2. *pentaphylla.*

1. **G. arborea,** *DC.* Syn. G. cochinchinense, *Pierre*; G. pentaphylla, *F.B.I.*; Chowal Dua, *Or.*

A dark green small tree or large bush, 8–20 ft. high. L. with 3-5 (rarely only 1) elliptic or ovate leaflets 1–4″ long. Fls. small, white, sweet-scented, subsessile, in short, axillary, furfuraceously rusty-tomentose panicles, ·5–1·5″ long, with suberect or spreading lanceolate or oblanceolate petals ·2–·28″ long. Berry ·5″, yellow.

Puri Division, in all ranges, especially on the Khandgiri sandstones. Fls. Oct.–Dec. Fr. Nov.-Jan. Evergreen.
Bark on twigs pale grey. Buds rusty tomentose. L. rachis 1-3″, lflts. alt. or opp. articulate glabrous shining, mostly with a blunt acumen, nervation obscure above, sec. n. about 6–8 reticulate. Petiolule ·15″. Fls. ·3″ diam. in very short

* See the note on thorns in Aurantieæ at the beginning.

peduncled cymes which are racemosely arranged in short panicles. Sep. minute, orbicular, rusty. Stamens not or very slightly dilated. Ovary base constricted above the disc, not or slightly mammillate, gradually passing into the thick style which slightly narrows upwards.

2. **G. pentaphylla,** *Correa.* Syn. G. cochinchinense, *Pierre*; Howmonicho, *Or.* (*f. Haslett*).

A shrub 2–4 ft. high, often gregarious, with pinnately 1–5 foliolate usually ell. or ell. oblong entire or obscurely-toothed leaflets 2–5″ by 1–2·5″. Fls. small white in pubescent or puberulous axillary and terminal panicles 1·5–3″ long, with erect obovate petals usually under ·2″. Berry ·3–·5″ depressed globose, often pinkish, glassy, 1-seeded.

Throughout the damper parts of the province. Common in village shrubberies in the Northern Tract! Santal Parganahs! Parasnath, *Anders*; Puri! Fls. most of the year, especially Sept.–Feb.

Stamens distinctly dilated, suddenly pointed at top. Ovary base scarcely distinct from the disc, very mammillate with large glands, the short thick style dilated upwards.

10. MICROMELUM, *Blume.*

Small trees without thorns. Leaves imparipinnate, with alternate leaflets, oblique at the base. Flowers in large terminal panicles. Calyx cupular, 3–5-toothed or lobed. Stamens 10, inserted round a short or long disc, alternate shorter. Style constricted at the base and deciduous. Ovules 2, superposed in each cell. Septa of small berry twisted. Cotyledons leafy, crumpled.

1. **M. pubescens,** *Blume.* Soitani, *K.*

A small tree, attaining 25 ft., leaves 8–18″, with 5–11 very large leaflets and large corymbs of white flowers ·5″, which are succeeded by fœtid, ovoid, yellow or scarlet berries ·5″ long.

Damp, esp. evergreen, forests. Singbhum, frequent! Hazaribagh! Puri, common in the southern Range! Bonai, *Cooper*! Fls. Jan.–Mar. Fr. May–July. Evergreen.

Lflts. ovate to lanceolate or ell.-oblong attaining 8″ by 3·5″, lowest sometimes only 1·5″, pubescent beneath, acuminate, base rounded oblique, rarely acute, sometimes cordate. Corymbs pubescent or tomentose, often 1 ft. across; fls. with a strong sweet smell, sometimes only ·3″, petals narrow oblong, valvate. Very pretty when in flower or fruit.

11. MURRAYA, *L.*

Unarmed small trees or shrubs, with imparipinnate leaves and small alternate leaflets with oblique base. Fls. in axillary or terminal corymbose, cymes rarely sub-solitary. Petals 5. Stamens 10, inserted round an elongate disc, filaments linear-subulate, alternate shorter. Ovary 2–5-celled, narrowed into a long deciduous style. Ovules 1–2. Berry 1-2-seeded.

1. **M. exotica,** *L.* Otli, *K.*; Athel, *S.*; Kamini, *H. Beng.*; Pitondi, *Gond.*; Ban Mallika, Harkankali, *Or.*; The Chinese Myrtle; Chinese Box.

A handsome small tree or shrub, with leaves 4–5″ long, small, shining, dark green leaflets, ·75″–2″ long, and white fragrant flowers in corymbs or few-flowered loose cymes.

Throughout the hills of the province in rocky ravines, not uncommon. Sameshwar Hills! Singbhum! Hazaribagh (on Parasnath)! Sant. Parg.! Ranchi, on the ghats! Palamau (Neterhat)! Bonai, *Cooper*! Angul, frequent! Sambalpur! Puri, Southern range! Fls. April-July. Fr. Dec.-Jan. Evergreen.

Lflts. 3-8 rigid glabrous entire. Petals ·5″ oblong-lanceolate. Ovary 2-celled. Berry red or yellow, ·5-·75″, ellipsoid apiculate 1-2-seeded, seated on the persistent calyx.

Var. **sumatrana,** *Roxb.*, is distinguished by its few-fld. cymes or subsolitary flowers, larger leaflets often 4″ by 1·75″ and subulate sepals, cymes 3-4-fld.

This is the more common wild form. In above localities, also Gaya ghats, Ranchi ghats and Neterhat. One Santal Parganahs form has obtuse sepals, and petals ·9″ long.

2. **M. Koenigii,** *Spreng.* Bakler, *Th.*; Barsanga, *H.*; Barsan, *Or.*

A shrub or small tree with pinnate leaves 5-16″ long, very oblique, strongly scented, lanceolate or ovate leaflets 1-3″ long, and terminal short-peduncled pubescent corymbs of odorous white flowers, ·5-·6″ diam.

Northern tract, wild along the Nepal boundary! Possibly wild in the jungles of the Mahanadi Delta but only seen by me near False Point! Not wild elsewhere but often seen in gardens.

Twigs pubescent. Leaflets entire or crenulate, usually acuminate, lowest much smaller, 6-15 prs., opposite or alternate. Petals linear oblong ·3″ long. Fruit succulent, ovoid or ellipsoid, ·3-·5″ long, pink, finally black. Seed large.

The leaves are used in curries and as a stomachic.

12. CLAUSENA, *Burm.*

Unarmed shrubs or trees with imparipinnate leaves and small flowers in cymes, panicles or racemes. Stamens 8-10 inserted round an elongated disc, alternate shorter, filaments usually dilated or arched and concave below the subulate tip. Ovary stipitate, style usually distinct, deciduous, ovules 2 collateral or superposed in each cell. Berry small, ovoid or globose. Seeds oblong, cotyledons plano-convex.

1. Shrubs, leaves pubescent.
   - Leaflets 9-15, 1·5-3·5″ long . . . . 1. *excavata.*
   - Leaflets 5-7, 3-7″ long . . . . 2. *pentaphylla.*
2. Small trees, leaves glabrous.
   - Leaflets 5-9, 3-6″ long . . . . 3. *Wampi.*

1. **C. excavata,** *Burm.* Ote-armu, Duki potum, *K.*; Agnijhal, *Or.*

An undershrub (in our area) of which the shoots attain 1·5-2 ft. only and die down annually, with alternate 9-many-foliolate leaves and terminal panicles of green flowers with 8 yellow stamens.

Chota Nagpur, common in the Sal forests in Singbhum! Western Bonai, *Cooper*! Fls. May-June. Fr. July-Aug.

Strongly scented. Branches tomentose from a perennial rootstock. Leaf-rhachis tomentose, 6-12″ long. Lflts. 1·5-3·5″, ovate to oblong or lanceolate with very oblique base, acuminate, hairy especially beneath when young and with large marginal pubescent glands. Branches of panicle cymose. Fls. ·25″ diam. hairy. Sep. 4 minute. Petals 4, 3-nerved. Ovary villous. Fr. ·75″, ellipsoid.

Used for indigestion and as a diuretic. The dried and powdered rootstock is also used by the kols for decayed teeth.

In British Bhotan it becomes a small tree.

2. **C. pentaphylla,** *DC.* Rowana, *Th.*; Ratanjot, *H.*

A very aromatic shrub 3–4 ft. high with all parts pubescent or tomentose. L. alt. ascending 5–7-foliolate, lflts. ell. or rhomboid acuminate alt. or sub-opp., 3–6″, conspicuously gland-punctate. Fls. 4-merous yellowish in terminal panicles. Berry verrucose, ·3″–·4″ long, broadly oblong, pale orange.

Common in the Sal jungles of northern Champaran. Fls. May–June. Fr. r.s.

Branchlets tomentose. Lflts. with oblique cuneate base, sometimes faintly toothed, pubescent esp. on the nerves, sec. n. 10–15 rather irregular. Petiolule ·05–·1″. Panicle 4–10″ long. Fls. ·25″ diam. Sep. triangular acute. Pet. oblong, concave, obtuse.

A much-valued Indian veterinary medicine. The bark is powdered and applied with sweet oil to flesh wounds. For sprains of tendons and ligaments, bruises and abrasions, the powder is first boiled in sweet oil for 15 minutes and applied as a poultice. Also used for ossification (see *Polo in India* by *Lieut.-Col. H. de Lisle*, p. 185).

3. **C. wampi,** *Blanco.* Wampi (from the Chinese).

A small tree occasionally cultivated for its edible berries which are greenish and about ·5″ diam. The leaves are 5–9-foliolate, 8–13″ long, glabrous. Lflts. 3–5·5″, obliquely ovate. Rind of fruit full of glands.

Fls. May. Fr. July.

13. CITRUS, *L.* Orange, Lemon and Citron.

Small trees or shrubs, usually with axillary thorns. Leaves 1-foliolate with often winged petiole. Flowers axillary, solitary fascicled or in small cymes, rather large, not greenish or yellow, sweet scented. Petals variable in number, imbricate. Stamens numerous, often in bundles with more or less connate filaments and oblong anthers. Ovary many-celled. Ovules 4–5 in each cell. Berry many-celled, succulent, with coriaceous or fleshy rind. Seeds sometimes 2–more -embryous with plano-convex often unequal cotyledons.

A. New shoots and leaves glabrous.
   Twigs pale, petals white. Fls. 2-sexual . . . . . . 1. *aurantium.*
   Twigs purple. Some or all the flowers tinged with pink. Fls. often polygamous . . . . 2. *medica.*
B. New shoots and underside of leaves pubescent . . . . . 3. *decumana.*

The above is *Brandis's* classification from his interesting account in *The Forest Flora of the N.W. and Central India*, but *Bonavia* has shown that among the cultivated races such definite lines cannot now be drawn between the species. For a full account see *Bonavia* (*Cult. Oranges and Lemons, etc., of India & Ceylon*, 1890).

1. **C. aurantium,** *L.* The Wild Orange. Narengi, *H.*

A small tree much-branched from near the ground, with green angular twigs and nearly entire scented leaves 2·5–5″ by 1–2″ with petiole ·25–·5″ long, narrowly winged or not. Fruit small globose or oblate not mammillate, 2–2·5″ diam., juicy and resembling a sweet lime in flavour, rind green, not thick.

Rocky secluded valleys in Singbhum and Bonai. Flowers not seen. Fruit ripens April–June.

Branchlets mostly armed with straight axillary thorns ·25–·75″ long. L. ell. acute or somewhat acuminate and narrowed at the base, entire or faintly crenate-serrate.

The flowers of this interesting plant should be looked for. In form and leaf it is very close to a wild *Citrus* in the Pachmari hills, but the ordinary wild *Citrus medica* is very different both in its larger leaves and thick-skinned elliptic mammillate fruit.

The orange is commonly cultivated in Chota Nagpur and Sambalpur.

2. **C. medica,** *L.* Jamira, *K.*; Jambir, *S.*; Nimbu, *H.*

Usually a very thorny bush, young shoots purplish, L. 3–6.″ Fls. often 1-sexual and pink. Fruit mamillate at the apex.

Wild in the Mayurbhanj hills, near ravines! Sometimes apparently wild in waste places especially on the Hazaribagh plateau, but not truly so. It is frequently wild in the moister valleys of the sub-Himalayas and in the Duars.

The cultivated varieties include the Citron, Lemon and Limes, but some of the last are without either the thick skin or mammillate fruit and pass into *C. aurantium*. The wild plant has a large ellipsoid very thick-skinned fruit.

3. **C. decumana,** *L.* Pamalo; Shaddock; Grape Fruit.

A small tree with leaves 6–9″ long and fruit often 6″ diam. with very large cells. Commonly cultivated.

14. ÆGLE, *Correa.*

Trees with 1 or more axillary thorns and alternate 3-foliolate leaves, with sub-crenulate crenate or nearly entire leaflets. Fls. rather large white or greenish white in axillary panicles. Petals 4–5, spreading imbricate. Stamens numerous, inserted round an inconspicuous disc with short subulate filaments and long anthers. Ovary ovoid with a stout axis and 8–20 cells, short style and deciduous stigma. Ovules many 2-seriate. Fruit large, several-celled and many-seeded, rind woody. Testa mucilaginous and woolly, albumen 0, cotyledons thick, fleshy.

1. **A. marmelos,** *Correa.* Lohagasi, *K.*; Sinjo, *S.*; Bel, *H.*; The Bael tree.

A small tree or sometimes m.s. with 1–2 strong thorns from the leaf axils. Lflts. elliptic or ovate-lanceolate, 2–4″ long, sessile with rhachis ·5–1″ long and petiole 1–2·5′ long. Fls. 1″ diam., greenish-white in very numerous lateral and sub-terminal simple panicles, 1·5–3″ long, appearing with the new leaves. Fruit 2–3″ diam. (larger in cultivated forms), globose or oval. Seeds embedded in a clear mucilage and yellow sweetly aromatic pulp.

Sometimes apparently wild in the Champaran hills! On high and stiff soil in Purneah, *Ham.* Wild in the hills of the Central and Southern tracts and also common in the scrub jungles of Puri, where it is sometimes the only tree left standing!

Fls., Fr. May–June. Fruit ripens May–June. Deciduous or sub-deciduous April.

A most valuable tree of which the properties in cases of bowel complaints, especially diarrhœa and dysentery, are well known. The fresh juice is also said (*Nadkarni*) to be a highly prized remedy in catarrh and feverishness, for which also a decoction of the root bark is used. The juice is used by Indian builders in mortar and cement, especially for bringing a glaze to the surface.

The leaves are sacred to Siva.

Var.? In ravines in the Santal Parganas I have found a mod.-sized thornless tree with broadly ovate leaflets, sometimes faintly

crenate, 2–4″ by 1·3–2·3″, shortly obtusely acuminate and puberulous both sides, lateral petiolules ·25″. It was neither in flower nor fruit.

The bael is frost-hardy. Very slow-growing.

15. FERONIA, *Correa.*

Only one species known. Generically it is distinguished from *Ægle* and *Citrus* by the placentæ not altogether reaching the axis of the ovary so that they are parietal. Ovules many. Stamens 10–12. Leaves imparipinnate.

1. **F. elephantum,** *Correa.* Kat-bel, Kochbel, *S.*, *Beng.*; Kaith, *Or*, *H*; The Elephant Apple or Wood-apple.

A small or rather large thorny tree with dark green odd-pinnate leaves, opposite small sub-sessile entire leaflets and green or dull red flowers, ·3″ diam. in short racemes or racemes panicled on short lateral branches with or without reduced simple or 3-foliolate leaves. Fruit 2·5–3″ diam., many-seeded, with a rough woody rind.

Common and perhaps indigenous on the cotton soil of Angul, Khandpara, Banki and Puri! Planted throughout the province but chiefly in the drier parts and not common elsewhere. Fls. Feb.–April. Fr. Nov.–Jan. Evergreen. New leaves with the flowers in Feb. and March.

Bark dark grey or black, rough. L. fascicled, about 3″ long, with 5–7 elliptic or obovate leaflets about ·5–1″ long, with large marginal glands and often notched at apex, rhachis narrowly winged. Pedicels glabrous, articulate on the pubescent peduncle. Sepals minute open in bud, soon withering. Petals green or reddish, imbricate, oblong, ·12″. St. usually 10, bases adnate to the large woolly disc. Anthers red.

The wood is sometimes used for agricultural implements. The pulp of the fruit is edible and aromatic and has much the same properties as the bael. It is also used for affections of the gums and throat. The gum is also given in diarrhœa and dysentery.

FAM. 37. SIMARUBACEÆ.

Trees or shrubs with bitter bark. Leaves alternate, usually large and pinnate, stipules 0 or deciduous. Flowers small, in terminal or axillary panicles or cymes, regular, 3–5-merous. Petals rarely 0, hypogynous. Disc annular or elongate, simple or lobed. Stamens isostemonous or diplostemonous, inserted at base of the disc, filaments free, often with a scale at the base. Ovary free, deeply 2–5-celled and -lobed with as many free or connate styles and capitate stigmas; ovules 1 in each cell, raphe ventral. Fruit samaroid or of several drupels or baccate, the carpels more or less distinct. Embryo straight or curved.

1. AILANTHUS, *Desf.*

Large trees. Fls. small, polygamous, bracteolate, panicled, 5-merous. Petals valvate. Stamens 10 in the male, 2–3 in the hermaphrodite flower, without scales. Ovary 2–5-partite, styles connate. Fruit of 1–5 samaras.

1. **A. excelsa,** *Roxb.* Pir nim, Ghoranim, *H.*; Ghorkaranj, *Kharw.*

A large tree with light-coloured bark, stout hoary tomentose branchlets, large pinnate leaves with 10–13 pairs of very coarsely toothed leaflets and large panicles of yellowish flowers.

Hazaribagh, frequent! Palamau! Gangpur! Orissa, frequent! Often near villages and roadsides. Fls. Jan.–March. Fr. May. Sub-deciduous in May and renews leaves in April to June.

Smell fœtid. Twigs ·3–1″ diam. with large leaf scars. L. 2–3 ft. long, with hoary tomentose rhachis. Lflts. 3·5–6″ by 2–3″, densely pubescent beneath, and pubescent above when young, acute or acuminate with a very oblique base, sec. nerves 12–20. Petiolule 1–2″, with two hairy glands near the base, and sometimes in place of the lowest leaflets also. Samaras often solitary, 1·75–2″ by ·5″, strongly nerved with a twisted base.

The ground bark is used in Indian veterinary practice.

FAM. 38. OCHNACEÆ.

Glabrous trees or shrubs with alternate simple stipulate leaves. Flowers usually large, panicled or umbellate, bracteate. Sepals 4–7, free imbricate, persistent and sometimes coloured in fruit. Petals 5–10, hypogynous deciduous. Disc enlarged after flowering. Stamens various, sometimes numerous, inserted on the disc; anthers basifixed, dehiscing by terminal pores or longitudinally. Ovary 2–10-celled with axile or parietal placenta, sometimes deeply lobed, styles connate or distinct at the apex. Ovules 1–2 in each cell or indefinite, ascending or rarely pendulous, raphe ventral. Fruit of several drupels or pyrenes each 1–4-seeded, or capsular.

1. OCHNA, *L.*

L. serrate. Fls. large yellow, in racemes or umbels. Disc large. Stamens many, filaments persistent, anthers deciduous. Ovary deeply 5–10-lobed, lobes 1-ovuled, distinct in fruit on the enlarged torus. Drupels each with 1 erect albuminous seed.

1. **O. squarrosa,** *Roxb.* Champa baha, *S.*; Pata champa, Koniari, Buin champa, *Or.*

A small tree or large shrub with ell., ell.-lanceolate to obovate acute or somewhat acuminate leaves, 3–7″ long, with very numerous fine oblique sec. n. Flowers handsome bright-yellow, fragrant, 1·5″ diam. in short lateral sub-corymbose rarely panicled racemes from the leaf scars. Sep. ·6–·75″, erect after flowering, but again spreading and deep purple in fruit.

In rocky ravines and cool rocky slopes. Rajmahal Hills, from Barhait northwards! Mayurbhanj, 2000 ft.! Angul! Puri forests, common! Athmallik, along valleys! Fls. April–May. Fr. r.s. Sub-deciduous Feb.–March, the new leaves often a beautiful crimson.

Attains 2 ft. girth, bark smooth pale grey, blaze dark pink, red on the wood. Buds perulate. L. often clustered, finely spinulose-serrate, but points deciduous and then crenulate or serrulate, base acute. Petiole ·17–·25″. Pedicels 1–1·25″, articulate.

2. **O. pumila,** *Ham.* Champa baha, *S.*

A very pretty undershrub with a long stout rootstock from which it sends up annually shoots 8–18″, rarely 2 ft. high, bearing umbels of showy yellow flowers, 1·5–2″ diam. Conspicuous in fruit from the spreading deep red sepals.

In open especially grassy forests and waste land. Champaran, on the bhabar! Gaya ghats! Ranchi: Horhap, Neterhat, etc.! Singbhum! Hazaribagh! Palamau! Manbhum!

Fls. Feb.–June. Fr. March–July.

The new shoots usually appear immediately after the jungle fires. L. broadly oblanceolate, 3–6″ by 1–2″, narrowed into the short petiole, finely sub-spinulosely serrate when young, rarely coarsely toothed, sometimes sub entire when old. Fls. on pedicels 1–2″ long, peduncle axillary 1–3″. Petals ·5–·75″. Drupels greenish, usually 4–6.

Campbell states that the root is used by the Santals as an antidote to snake bite and for certain menstrual complaints, consumption and asthma.

FAM. 39. BURSERACEÆ.

Trees or shrubs secreting oleo-resins in the cortex. L. alternate, impari-pinnate, usually with opposite leaflets stipulate or (in all the following) exstipulate. Fls. regular, small, often polygamous in axillary or terminal racemes or panicles. Calyx often minute, lobes 3–6 imbricate or valvate. Petals 3–6 imbricate or valvate. Disc free or adnate to the base of the calyx. St. twice as many as the petals inserted on the margin of or underneath the disc. Anthers 2-celled dehiscing longitudinally. Ovary free, 3–5-celled. Ovules 2 in each cell, axile pendulous anatropous. Fruit a drupe with 1–5 free or united pyrenes or dry and dehiscent, each pyrene 1-seeded. Albumen 0. Cotyledons generally twisted plicate or crumpled.

A. Flowers with a campanulate hypanthium lined by the disc.
  Fruit a globose drupe.
  Tree flowering before the leaves. Lflts. crenate pubescent . 1. *Garuga.*
B. Flowers with a small cupular or saucer-shaped calyx.
  1. Disc annular crenate.
    Tree flowering with the leaves. Panicles axillary, diffuse . 2. *Bursera.*
    Panicles pseudo-terminal racemiform. Fruit trigonous . . 3. *Boswellia.*
  2. Disc at base of small cupular calyx.
    Panicles cymose dichotomous exceeding the leaves . . . 4. *Commiphora.*

1. GARUGA, *Roxb.*

Trees with pubescent branchlets and exstipulate leaves clustered at the ends of the twigs with opposite subsessile crenate leaflets. Flowers polygamous in much-branched panicles. Calyx campanulate, 5-fid, valvate. Disc conspicuous, lining the calyx-tube. Petals and stamens inserted on its margin. Ovary sessile or shortly stipitate 4–5-celled, stigma capitate 4–5-lobed. Fruit a drupe with 1–5 1-seeded pyrenes.

1. **G. pinnata,** *Roxb.* Jiga, Kekar, *H., Th.*; Armu, *K.*; Kandwer, *S.*; Karur, *Bhumij*; Kosromba, *Mal P.*

A large or m.s. tree, handsome in full foliage, with odd-pinnate leaves 12–18″ long, 8–16 prs. ovate-lanceolate lflts. attaining 4·5″

by 1·5″, crenate caudate, pubescent both sides, lowest pair usually very short and reflexed. The yellow campanulate flowers, ·25″ long, are borne when the tree is leafless in numerous panicles 4–6″ long from the leaf scars at the tips of the branchlets.

Throughout the area. Chiefly in the valleys, ghats or cool sides of the hills in the hotter districts. Fls. March–April. Fr. June–Aug. Leafless March–May. Old leaves turn red before falling.

Bark pale grey, smooth or flaky. Blaze in young trees thin, pink, in old trees thick with outer brown dead bark, then pink or deep crimson streaked with white. If the bark is recently shed a chlorophyll layer occurs in place of the brown outer layer. Lflts. hairy with 12–16 sec. n.; petiolules ·08–·12″. Calyx-tube very hairy, sepals half as long as the erect linear-oblong petals. Filaments hairy. Fruit globose, yellowish-green, ·75″ diam., with 2–4, rarely 5 pyrenes.

The leaves are very frequently attacked by red galls which are very conspicuous in the autumn. It is a good tree for the reclamation of grass lands in damp districts, being among the fire hardy species. It grows readily from cuttings and coppices easily. It is not much used. *Hamilton* says that "Jiga" is used for canoes and coarse furniture, and remarks on the green plicate cotyledons.

2. BURSERA, *L.*

Trees with exstipulate leaves. Fls. small polygamous or 2-sexual in axillary panicles, 4–6-merous, with annular crenate disc free from the calyx-tube and 8–12 stamens inserted at its base or alternately on and between the crenatures. Ovary free, 3–5-celled. Drupe with 3–5 pyrenes.

1. **B. serrata,** *Colebr.* Syn. Protium serratum, *Engl.*; Kandior, Kariar, *K.*; Armu, *S*; Karonda, *Kharw.*; Sari, *Mal P.*; Garur, Nimburu, Limbru, *Or.*; Mohi, *Gond.*

A m.s. tree with leaves 6–12″ long, lflts. 3–4 prs., oblong, 3–5·5″, caudate, entire or more or less serrate, pubescent on the 6–12 sec. n. beneath. The very small green flowers ·12″ diam. are borne when the tree is in full leaf in lax panicles from the leaf axils and from the axils of fallen leaves.

Throughout the area but not at all gregarious. Chiefly among rocks and on the cool sides of hills and streams in the central area! Champaran! Angul and Puri, common! Sambalpur, rare! Athmallik, along rivers! Common in the higher hills in both the Central and Southern area! Fls. April. Fr. May. Evergreen or nearly so, renews leaves in April.

Bark grey, slightly cracked, blaze deep brown (in old trees), then thick deep pink. Twigs pubescent. Petiolules ·25–·5″. Calyx tube very shallow with small lobes. Petals spreading above. Style very short. Fruit globose red when ripe, about ·5–·75″ diam. with 1–3 stones.

It is a tall and valuable timber tree in Burmah but not much used except as building posts in our area. It coppices from the cambian ring.

Var. **serratissima.** Lflts. 4·5–7·5″ long, very deeply and coarsely serrate. Sambalpur! Kalahandi, *Cooper*! Along streams.

3. BOSWELLIA, *Roxb.*

Trees, often with a papery bark. L. exstipulate with opposite sessile usually serrate leaflets. Flowers rather small racemed or panicled. Calyx small 5-toothed, persistent. Petals 5 imbricate. Disc annular crenate. Stamens inserted at the base of the disc 5 long and 5 shorter. Ovary sessile 3-celled, stigma 3-lobed, ovules 2 in each cell, pendulous. Drupe trigonous, containing 3 pyrenes.

1. **B. serrata,** *Roxb.* Salga, Salai, Sali, *H.*; Salga, *S.*, *K.*

A pretty tree with green, grey or reddish bark peeling off in thin flakes. Leaves 12–18″ long with 9–16 prs. opposite coarsely crenate-serrate leaflets 1·5–3″ long, and numerous racemes of smallish white flowers at the tips of the branches, usually appearing when the tree is bare of leaves.

Very common on dry hills in the Central and parts of the Southern area, but not common in S.P., Angul or Puri! Fls. Jan.–March. Frt. May–June. Deciduous Jan.–May or June.

Bark very thin grey flaky, with chlorophyll layer beneath the thin outer layer. Blaze flushed with lighter and darker pink; from it exudes small drops of resin.

L. at the ends of the branchlets. Lflts. lanceolate or ovate-lanceolate, glaucous beneath, pubescent on the nerves above, sometimes sub-lobed. Racemes 4–8″, pubescent, sometimes with short branches, crowded near the apex but not really terminal, as the branch grows through them and they are below the leaves in fruit. Calyx cupular, 5–6-lobed, villous. Petals ·25″, oblong-ovate with thickened base. Disc scarlet, fleshy, papillose. Anthers sagittate introrse. Fruit ·5″, 3-gonous, with three valves and 3 winged hard pyrenes.

The wood is used for charcoal. The tree yields the Indian Olibanum, a golden-yellow gum-resin (Inban, loban, *S.*), very fragrant and transparent. The leaves hung up in cattle-sheds drive away flies. Can be grown from large cuttings.

4. COMMIPHORA, *Jacq.*

Trees or shrubs, often spinescent. L. alt. 3-foliolate or imparipinnate; stipules 0. Fls. small polygamous fascicled or in dichasial panicles. Calyx cupular or tubular, 4-, rarely 5–6-lobed, valvate, persistent. Pet. 4, rarely 5–6, inserted on or under the margin of the cup-shaped disc. St. 8–10 inserted with the petals, alternate longer. Ovary ovoid, sessile, 2–4-celled, stigma 3–4-lobed; ovules 2 in each cell, collateral. Fruit drupaceous with 2–6 pyrenes.

1. **C. caudata,** *Engl.*, syn. Protium caudatum, *W. & A.*, is a deciduous small tree or shrub with greenish papery bark peeling off in thin flakes. L. 3-foliolate (in our specimens, but sometimes 5–7-foliolate), leaflets orbicular or ovate suddenly acuminate 1·25–3″ long, nervation very fine reticulate. Fls. yellowish in long-peduncled slender dichasial panicles 3-many-flowered, 2–6″ long. Drupe ovoid, ·4″ long.

Planted on the Orissa coast as near Konarak!, probably from cuttings, and hence it appears at present shrubby. The sap is abundant and fragrant. Fls. May. Deciduous.

FAM. 40. MELIACEÆ.

Trees or shrubs without (exc. *Chloroxylon*) translucent glands in the leaves. Leaves alternate pinnate, rarely 2–3-pinnate, exstipulate. Flowers regular, usually in axillary panicles. Calyx 3–6-toothed, -partite, or sub-entire. Petals 3–6, sometimes cohering at the base. Stamens 4–12, usually twice as many as the petals, more or less completely united into a tube except in the tribe *Cedreleæ*, outside the disc. Tube usually toothed. Disc frequently tubular and sheathing the ovary, sometimes pulvinate, rarely absent, sometimes adnate to the staminal tube. Ovary usually free, 2–5-, rarely 6-celled. Style 1 with disciform or capitate stigma. Ovules 2 or more in each cell, rarely solitary. Seeds sometimes arilled or winged. Albumen thin or absent.

A. Ovules several or many in each cell. Seeds winged.
  I. Stamens not united into a tube. Capsule under 1·5″.
    Perfect stamens 10. Leaves gland-dotted . . . . 1. *Chloroxylon.*
    Perfect stamens 4–6. Leaves not gland-dotted . . . 2. *Cedrela.*
  II. Stamens united into a tube. Capsule over 1·5″.
    a. Exotic.
      Anthers between the teeth of st. tube . . . . 3. *Swietenia.*
    b. Indigenous.
      Anthers between the two teeth of nearly free lobes of the tube . . . . 4. *Soymida.*
      Anthers on margin of almost entire st.-tube. . . 5. *Chickrassia.*
B. Ovules 1–2 in each cell. Seeds not winged. St. united into a tube.
  I. Lflts. mostly toothed. Petals usually spreading.
    a. Fruit drupaceous. St. tube oblong.
      Leaves pinnate . . . . 6. *Azadirachta.*
      Leaves 2–3-pinnate . . . . 7. *Melia.*
    b. Fruit nearly dry 5-gonous. St. tube very short . . 8. *Cipadessa.*
  II. Leaflets entire. Petals erect or sub-erect (exc. 9).
    a. Terrestrial trees.
      Petals ovate-oblong. Leaflets 3 . . . . . 9. *Walsura.*
      Petals shortly oblong. Leaflets 5–11 . . . . 10. *Heynea.*
      Petals concave 3. Leaflets many . . . . . 11. *Amoora.*
      Petals concave 5. Leaflets 3–7 . . . . . 12. *Aglaia.*
    b. Littoral trees. Lflts. 2–4. Fruit very large . . 13. *Carapa.*

1. CHLOROXYLON, *D.C.*

L. paripinnate. Flowers 5-merous in terminal and axillary panicles, petals spreading clawed. Stamens in the depressions of the 10-lobed disc, not connate into a tube, alternate shorter. Ovary sunk in the prominent disc, 3-lobed and -celled. Ovules about 8 in each cell. Capsule coriaceous, loculicidally 3-valved. Seeds compressed exalbuminous, winged above.

1. **C. swietenia,** *D.C.* Sengel-sali, *K.*; Bharhul, *Khaw.*; Bhira, *H.*; Indian Satinwood.

A small or m.s. tree, larger in the south, with thick corky bark, pretty, greyish- or glaucous-green foliage, leaflets 10–20 pairs, about 1″ long, gland-dotted. Fls. white, ·25″ diam., on the cymose branchlets of pubescent 3–5″-long panicles, which are clustered towards the ends of the branches from the leaf scars. Capsule 3-gonous, oblong-ovoid, 1–1·75″, 3-celled.

Not recorded from the Northern area. Common in the Central area but local, chiefly on northern slopes! Southern area: chiefly in the drier forests, not common in Puri, chiefly Durgapur range in Angul! Orissa States, in open forest, chiefly on lime soils and generally small, *Cooper.*

Attains 4·5 ft. girth. Lflts. rhomboid-oblong with rounded apex, petiolule ·08–·1″, rhachis with petiole together 8–12″ long.

The poles are largely sought after for building and implements, hence the scarcity of large trees. It is a very good coppicer. It thrives with heavy grazing owing to the very acrid juice, which blisters the skin, making it unpalatable even for goats. (Hence the Kol name sengel-sali, sengel = fire.)

2. CEDRELA, *L.*

Trees with pinnate leaves. Fls. short-oblong, white in terminal and sub-terminal panicles, 4–6- usually 5-merous. St. sometimes with alternating staminodes, inserted on the fleshy disc which is more or less adnate to the base of the ovary. Ovary 5-celled. Cells

with several 2-seriate pendulous ovules. Capsule septifrugally 5-valved, globose when young, then ellipsoid or oblong. Seeds many imbricate, winged at one or both ends.

1. **C. toona,** *Roxb.* Katangai, Koronga, *Ho.*; Katangari, *M.*; Tun, *H.*; The Toon Tree.

A m.s. or large tree with large spreading leaves 1–2·5 ft. long, with 5–12 prs. of alt. or opp. lanceolate or oblong-lanc. caudate or finely acuminate glabrous or pubescent entire or faintly undulate leaflets 3–7″ long (on same leaf), with long petiolules ·4–·5″ and oblique acute bases rounded on the acroscopic side and 13–18 sec. n. Terminal odd leaflet usually present. Fls. ·16–·2″ long in drooping or sub-erect panicles on the new shoots. Seeds winged both ends.

Wild in the Northern tract in the Ramnagar Hills and Purneah! Wild generally in the Central and Southern tract in valleys among the hills! Largely planted everywhere. Fls. March–April. Fr. June–July, but the capsules often remain a whole year on the tree. Deciduous Dec.–Feb.

The following varieties occur which I have endeavoured to name as far as possible in accordance with *C. de Candolle's* monograph.*

A. Branchlets puberulous when young only. L. glabrous when mature except the nerve axils beneath.

α. **typica.** Panicles glabrous or nearly so, long and drooping. Flowers without staminodes. Anths. minutely apiculate. Capsules ·75–·9″, smooth, sparsely lenticellate.

Southern range, Puri! Narsingpur! Chiefly cultivated elsewhere.

β. **Hainesii** *C.D.C.* (sp.) As in *typica* but staminodes 5, filiform and panicle only 8–9″, erect. Singbhum! also apparently (but flowers not seen), Angul!

γ. **Hasletii** *Haines* (Fl. Ch. Nag.) Lflts. opp. 6–10 prs. only, under 4″. Panicles erect, 6″, glabrous. Fls. ·16″. Anthers with a tail ½–¾ as long as themselves. Capsule under ·65″. Santal Parganas, Khatikhund, *Haslett!*

B. Branchlets and leaves more or less permanently pubescent or puberulous. Panicles shorter than the leaves.

δ. **multijuga.** L. often 2 ft. in length. Singbhum! Bonai! It scarcely appears to merit the rank of a variety. Filaments glabrous, therefore not var. *pubescens*.

2. **C. brevipetiolulata,** *n. sp.*

A small tree with permanently pubescent twigs, petioles, rhachis and midrib above remarkable for the very short petiolules of the leaflets, which do not exceed ·1″. Lflts. about 10–15-jugate, much as in *C. toona*.

Mals of Orissa!

The flower and fruit has not been seen and the species therefore has not been described. It is the same tree apparently as Barber's No. 5774 from the Anamalais, which was not taken up in the *Madras Flora* owing to the same lack of inflorescence.

3. SWIETENIA, *L.* Mahogany.

Large trees with pari-pinnate leaves and opposite or sub-opp. leaflets. Fls. 2-sexual small greenish panicled. Calyx 5-fid. Petals spreading. Anther tube urceolate or ovoid-cylindric with the anthers between the 10 small teeth. Disc annular. Ovary 5-celled with many ovules. Fruit a large woody septifrugally dehiscent capsule with numerous pendulous 2-seriate winged seeds in each loculus.

* Vide *Rec. Bot. Surv. India*, III, 4, on the Indian species of *Cedrela*.

1. **S. macrophylla,** *King.* Large-leaved Mahogany.

A large tree, leaflets generally 4 pairs somewhat like those of a *Cedrela* with very oblique base, larger about 6″ long. Flowers greenish, ·3–·4″ diam., sweet smelling, in narrow supra-axillary panicles about 3·5–5″ long. Capsules like large inverted clubs, erect, 5–6″ long, very woody.

Now somewhat largely planted. Purneah! Dumka! Ranchi, etc.! Flowers in April when in full leaf. Fruit ripens nearly a year later. Nearly evergreen but leaves fall end of Feb.–March.

Bark of twigs brown. Leaf rhachis 6–8″. Lflts. sub-falcate lanceolate acuminate with 8–12 pale sec. n. Petals greenish, oblong, ·15″. St. tube cream-coloured, anthers included, inserted below the sinus. Disc red.

2. **S. mahogani,** *L.* Small-leaved Mahogany.

A large tree with rather rugose grey-black bark, pinnate leaves with 2–4 prs. of leaflets 1·2–2″ long only and panicles of greenish flowers ·3″ diam. with yellow staminal tube.

Often planted: Muzaffarpur, Dumka, etc.! and thrives well towards Orissa, but is stunted in Chota Nagpur. Fls. April–May. Renews leaves April and is practically evergreen. It flowers rather later than *S. macrophylla*.

Leaflets very oblique, often sub-falcate, with a short slender apex. Panicles quite glabrous, 1·5–2″, shorter than the leaves. Petals obovate-oblong, st. tube ·12″ long with 10 sharp teeth.

It does not set seed so freely as the last.

4. SOYMIDA, *A. Juss.*

A tree with paripinnate leaves. Fls. in axillary and terminal panicles. Pet. 5 imbricate, obovate, clawed, spreading. St. tube cupular 10-cleft or sometimes stamens nearly free and spreading, lobes fleshy, apex minutely 2-lobed with the anther in the sinus. Disc flat. Ovary 5-celled, cells with about 12 pendulous 2-seriate ovules. Style short. Stigma large capitate, slightly lobed. Capsule 5-valved woody, valves separating from a large 5-rayed central axis. Seeds numerous, large winged both ends, albuminous, cotyledons foliaceous.

1. **S. febrifuga,** *A. Juss.* Rohini, *K.*; Ruhen, *S.*; Rohana, *H.*, *Kharw.*; Suam, *Or.*

A large or m.s. tree with thick wrinkled branchlets and leaves 9–18″ long with 3–6 prs. of opposite or sometimes alt. leaflets 2–4″ long, sprinkled when young with small peltate glands. Fls. ·3–·4″ diam., white, with sometimes green on the petals, in large terminal panicles. Conspicuous in fruit from the large ellipsoid or obovoid pendant woody septifragal capsules 3″ by 2″.

Central and Southern tract. Singbhum, rare (Chirubera)! Gangpur, common! Manbhum! Hazaribagh! Palamau! Puri, not very common! Angul, chiefly in the dryer forests! Narsingpur, ditto! Mayurbhanj, ditto! Sambalpur, frequent! Common in the other states of Orissa, *Cooper*, *Grieve*. It is very usual on poor lime soils and also grows on cotton soil.

Fls. with the old falling leaves Feb.–March or with the new leaves April–May. Fr. May–June. Deciduous.

Bark dark brown, splitting into oblong flakes on old trees. L. usually red when young and often with permanent red rhachis and midrib. Lflts. sessile or nearly

so, broadly oblong or elliptic, obtuse with very oblique base, glabrous. Sep. 5, short imbricate. Staminal tube usually erect.

"The wood is extremely hard and very dark red-brown, very durable and makes a beautiful furniture, if well seasoned. It is somewhat cross-grained," *Gamble*. It is used for building, for oil mills and other purposes, but is usually taken as poles. It coppices well. The bark is bitter and astringent and is employed in dysentery and diarrhœa. "A decoction is given for rheumatic swellings," *Campbell*. "It is said to be as good as Sunari (*Cassia fistula*) for tanning purposes," *Cooper*. "Wt. about 75 lbs. P = 1024 according to *Skinner* but only 626 according to *Fowke*," *Gamble*.

5. CHUKRASIA (sometimes spelt *Chickrassia*), *A. Juss.*

1. **C. tabularis,** *A. Juss.*

In a pamphlet entitled "On the Flora of Behar and the mountain Parasnath," by Thomas Anderson, formerly Superintendent of the Royal Botanic Gardens, Calcutta, it is stated that *Chickrassia tabularis* occurs on Parasnath from base to summit. This is the only record, and I suspect an error as I have failed to find it on Parasnath or anywhere else in Bihar and Orissa.

C. tabularis has 5–12 prs. of leaflets. White flowers ·5″ long, with erect oblong petals and a woody capsule about 1·5–1·75″ long.

6. AZADIRACHTA, *A. Juss.*

Tree. Leaves pinnate, leaflets toothed, petals spreading, disc annular. St. tube 10-toothed, anthers opposite the teeth. Ovary 3–5-celled, ovules 2 in each cell superposed. Drupe 1-celled and 1-seeded. Cotyledons oblong-obovate, fleshy, sessile, epigeal with a long stout hypocotyl on germination.

1. **A. indica,** *A. Juss.* Syn. Melia Azadirachta, *L.*; Nim, *H.*; The Neem Tree; Margosa.

A handsome tree, leaves with 5–9 prs. of coarsely-serrate unequal-sided leaflets and axillary panicles of white scented flowers. Drupe ·5–·75″ ellipsoid, yellow when ripe.

Believed not to be indigenous in the province but occurs as if wild on some of the hills in Puri district and in jungles in Hazaribagh. It is frequently self-sown near gardens and villages and very commonly planted. Fls. March–May. Fr. June–July, and the seed germinates in July and Aug. of the same season. Evergreen.

L. 8–15″, lflts. 1–3″, sometimes lobulate near the base. Fls. ·3″ diam. St. tube ·2″ long. Cotyledons ·3–·4″ long.

The wood is good and used for various purposes. The bark is bitter, and nearly every part is used medicinally in intermittent fever and as a tonic. The ripe fruits are largely collected for the oil, which is especially useful in parasitic skin-diseases and for dressing foul ulcers. Internally it is anthelmintic. The twigs are used for tooth-brushes. It is a good avenue tree.

The first leaves after germination are pinnatifid at base.

7. MELIA, *L.*

Trees with 2–3 pinnate leaves and 2-sexual flowers in large axillary panicles. Calyx 5-lobed or sep. 5 imbricate. Pet. 5, free. Disc annular. St. tube cylindric dilated and laciniate at the mouth; anthers 10 included on or near the margin of the tube, apiculate. Ovary 5–8-celled, style cylindric, stigma capitate; ovules 2 superposed. Fruit a drupe, cells 1 or more, 1-seeded. Seeds pendulous elliptic, testa crustaceous, albumen fleshy, thin, cotyledons foliaceous, radicle terete superior.

L. 2-pinnate. Fls. white. Drupes over 1″ long . . . . . 1. *composita*.
L. mostly 3-pinnate. Fls. lilac. Drupes under 1″ long . . . . 2. *azedarach*.

1. **M. composita,** *Willd.* Syn. M. dubia, *Cav.*; Ghora-nim, Mahanim, *H.*; Batra, *Or.*

A very large tree with spreading crown and 2-pinnate leaves up to 2·5 ft. long clustered towards the ends of the branches. Fls. white, ·5″ diam., with spreading and reflexed greenish petals in numerous axillary stellately tomentose scurfy panicles 5–8″ long. Drupes 1–1·25″ long with very hard endocarp.

Forests of Angul and Puri, rather frequent in Angul! Fls. Feb.–March. Fr. Dec.–Jan. New leaves with the flowers. Deciduous.

Bark reddish, smooth and flaking. Blaze thin, crimson, then white. Twigs stout, brown. Shoots stellately scurfy. Pinnæ up to 8″ long 3-foliolate or with up to 3–6 prs. of leaflets. Lflts. mostly ovate-lanceolate and acuminate, 1·5–2·5″, glabrescent, crenate or crenulate. Petiolules ·15–·3″ minutely pubescent when old. Fls. ·25″ long. Sep. small lanceolate. Pet. ·3″, spathulately-linear pubescent. St. tube narrowly tubular with over 20 short linear teeth, inside silky. Drupe with 1 chestnut-coloured seed with large embryo.

"Wood soft. Growth rapid, 2–3 rings per inch of radius in Madras to 7 rings in some Bengal specimens. Wt. 26–33 lb. The wood will probably be found useful for tea-boxes and similar purposes and the tree should be cultivated on account of its rapid growth." *Gamble.*

2. **M. azedarach,** *L.* Bakain, *H.*; Bokom baha, *S.*; The Persian Lilac.

A m.s. tree, but flowering when small, with mostly 3-pinnate leaves up to about 2 ft. long chiefly towards the ends of the branches. Fls. lilac with deeper purple staminal tube, in axillary panicles. Drupe ·5–·75″, yellowish with very hard endocarp.

Cultivated in all stations! A native of Upper Burmah!

Fls. May–June. Fr. ripens Nov.–Dec., but often remains on the tree throughout the cold weather. Leafless Dec.–April. Bark thick and deeply fluted in old trees, smooth in young. Shoots somewhat rusty with stellate hairs. Pinnæ up to 12″ long. Sec. pinnæ 1–3-foliolate. Lflts. mostly lanceolate acuminate, ·5–2·5″, glabrescent serrate or gashed. Fls. ·25–·3″ long, sweet-scented. Drupe often 5–6-celled, several cells usually with a long narrow seed with brown testa and fleshy linear-oblong cotyledons.

"Wood useful and pretty, handsomely marked. Wt. averages about 38 lb. Growth quick, often very quick, 3–4 rings per inch," *Gamble.* I have grown trees some 30 ft. high in 3 years from seed so that it is useful when quick growing trees are required. The inner bark contains a resinous alkaloidal substance and is used as an anthelmintic. The fruits are poisonous and are used in leprosy and scrofula (*I. P. & D.*).

8. CIPADESSA, *Blume.*

Shrubs or small trees with odd pinnate leaves, opp. or sub-opp. leaflets, axillary or extra-axillary peduncled panicles and sub-globose fls. Petals 5 oblong spreading valvate. Staminal tube deeply 10-lobed, lobes linear, loosely cohering forked, anthers short in the forks. Disc shortly cupular, adnate to base of the staminal tube. Ovary 5-celled, ovules 2, collateral. Fruit scarcely fleshy 5-gonous.

1. **C. futicosa,** *Blume.* Nalbali, *Or.*

Small tree or large shrub with long weak sub-sarmentose branches, leaves 5–12″ long with 7–11 opposite variously-toothed lflts. and small cymose panicles of small white flowers.

Valley forests in Singbhum, frequent in Saranda and Porahat! Parasnath! Puri and Angul, very common! Narsingpur! Probably all the Orissa States. *Cooper.* Fls. March–June. Fr. May–Nov. Deciduous in March.

12

Whole plant usually more or less pubescent. Lflts. from ·75″ (at base of leaf) to 5″ by 2·25″, terminal oblong acuminate, petiolules ·12–·5″. Panicles narrow, 3-4″ long, including the long peduncle. Fruit under ·25″ diam.

9. WALSURA, *Roxb.*

Trees with 1–5-foliolate leaves and opp. lflts. Fls. in axillary and terminal panicles. Calyx short, 5-fid or -partite. St. 8 or 10 free or connate, lobes notched or 2-cornute. Disc annular. Ovary short 2–3-celled sunk in the disc. Fruit baccate 1- rarely 2-celled and -seeded. Seed enclosed in a fleshy aril, exalbuminous.

1. **W. piscidia,** *Roxb.* (inc. W. ternata, *Roxb.*). Mundika, *Or.*; Siloi (Gaya); Bakom, Kuruwan (Samb.).

A bushy tree or scarcely more than a shrub with pinnately 3-foliolate leaves, oblong or somewhat ovate-oblong leaflets 3–5″ by 1–2·25″, pale glaucous beneath and very shining above, and white or yellowish small flowers with erect very slightly imbricate petals in axillary and terminal panicles 3–5″ wide composed of several long-peduncled partial panicles. Panicles from the upper leaf axils and brown hairy leaf scales of the new shoots. Frt. ·3″ closely tomentose.

Along the Hazaribagh-Gaya Ghats in rocky ravines! Under the shade of immense gneiss rocks at the top of Koderma hill (Pal.)! Not found elsewhere in the Central tract. Common in the Puri division, chiefly in the southern range! Angul, chiefly in ravines! Sambalpur, chiefly on the shales near rivers! Fls. Feb.-June. In the Central tract it is partially deciduous at the time of flowering.

Bark grey, slightly cracked. Blaze rather hard, thick, pink then yellowish. Innovations brown tomentose. Lflts. usually rounded both ends or somewhat acuminate (var. *ternata*), sec. n. slender, about 10, very finely reticulate between; petiolules ·15–·3″, terminal ·75–1″. Peduncles 1–3″, usually thickened upward. Fls. ·1–·12″ long. Sep. one-fourth to one-third as long as corolla. St. tube half length of petals cleft for one-third to two-thirds of its length into 10 2-cornute segments, alt. slightly shorter, with yellow apiculate anthers inserted between the two very small horns. Disc short annular.

The bark is used to kill fish. An oil is said to be obtained from the wood by heating the chips. It is used for itch.

The following are sometimes considered as distinct species:—

Var *α*. **typica** (W. piscidia, *Roxb.*, *F.B.I.*, p. 564). Lflts. rounded at apex. Peduncles 1·5–3″ thickened upwards. Sep. scarcely one-fourth as long as petals. Pet. 4 mm. long, erect oblong or lanceolate-oblong, yellowish. Central tract and Puri!

Var *β*. **ternata** (W. ternata, *Roxb.*, *F.B.I.*, p. 563). Lflts. often somewhat acuminate. Peduncles usually under 1″ long, uniform. Sep. one-third as long as petals. Pet. 3·5 mm., erecto-patent ell. or ell.-oblong, white, shorter segments of st. tube sometimes not horned. Sambulpur!

The depth of the lobing of the staminal tube used in the *F.B.I.* as a sectional character is very variable. Fig. 65 of *Brandis' Indian Trees* unites the two vars. having the long inflorescence of *typica* and the pointed leaves of *ternata*!

10. HEYNEA, *Roxb.*

Trees or shrubs with 5–11-foliolate leaves and opp. quite entire lflts. Panicles terminal and axillary, corymbose. Calyx short 4–5-fid. Petals 4–5 oblong sub-erect. St. tube cleft into 8 or 10 linear 2-toothed segments. Disc annular. Ovary immersed in the annular fleshy disc, 2–3-celled, narrowed into the short style. Fruit dehiscent, 1-celled, 2-valved, 1-seeded. Seed arillate, cotyledons large thick fleshy. Raphe large.

1. **H. trijuga,** *Roxb.*

A small ornamental tree with odd-pinnate leaves 12–18″ long, 2–4 pairs of ovate acuminate leaflets 3–5″ long, and small white flowers in lax corymbose panicles on long slender peduncles 7–12″ long. Fls. shortly oblong ·15–·2″. St. tube cleft about half way into 8–10 segments which are forked with apiculate anthers in the forks. Ovary 2-celled, cells 2-ovuled. Fruit reddish, ·5″, ellipsoid, with 2 thin coriaceous valves, and with 1 (rarely 2) pendulous seed (from an ascending funicle) with a thin white fleshy aril.

Sameshwar Hills, Champaran! Valleys in Singbhum! Ranchi (Kolomda, 2000 ft.), *Gamble*! Bonai, *Cooper*! Mayurbhanj, in the mountains 2000 ft.–3000 ft.! Often planted in Ranchi, etc. Fls. March–May. Fr. Aug.–Nov. Evergreen.

Attains about 3–4 ft. girth. Bark cracked or fluted, brown (or grey with red in the cracks), blaze red to crimson. Lflts. pale and somewhat pubescent beneath or glabrous, end one attains 6·5″ by 3″, base of lateral straight, rounded or obtuse with petiolules ·25–·75″. Panicles (without peduncle) 2-4″ only. Sep. broad pubescent.

The wood does not seem to be used. Gamble says that the seeds give an oil used for burning by the Nepalese.

The first several leaves of the seedlings are large, simple and ovate, the next 3-foliolate.

11. AMOORA, *Roxb.*

Trees sometimes with milky juice, with odd-pinnate leaves and entire leaflets. Fls. diœcious (or hermaphrodite in form), panicled, or females spicate or racemose. Calyx 3–5-partite. Petals 3 concave imbricate. St. tube subglobose or campanulate, 6–10-crenate or -toothed with the 6–10 anthers at the crenatures. Disc 0. Ovary 3(-5)-celled. Fruit usually coriaceous, ultimately loculicidally 3–4 (rarely 5) -valved. Seeds 1–4 with a fleshy aril.

Male flowers in panicled spikes or racemes, fem. in long simple spikes . . . . 1. *rohituka.*
Male flowers in panicled cymules, females in a short sub-racemose panicle . . . . 2. *spectabilis.*

1. **A. rohituka,** *W. & A.* Sikru, *Ho.*; Sikaroro, *M.*; Pitraj, Tiktaraj, *Beng.*; Mangai, Khanda, *Or.* (also Gilakusum or Panikusum in Puri).

A handsome small or m.s. tree with low spreading crown of large dark green glabrous pinnate leaves 1–3 ft. long with 4–7 pairs of leaflets 3–9″ by 1·5–4″, decreasing in size towards the base of the leaf and small white flowers in lax simple (female) or branched (male) spikes. Capsule 3-valved, yellowish or flesh-coloured, 1–1·5″ diam., glabrescent.

Throughout the province but outside Orissa only wild along watercourses in evergreen or semi-evergreen forest. Champaran, frequent! Purneah! Singbhum! Porahat! S.P.! Puri, common! Often planted in other districts. Fls. Aug.–Sept. Fr. May–June. Ev.

Bark smooth. Blaze thick crimson with bold white streaks. Branchlets stout, shoots brown-pubescent but glabrescent. L. rhachis grey with few scattered brown microscopic scales. Lflts. sometimes falcate, slightly puberulous beneath when very young but some glabrous and not at all scaly, green beneath, shortly sharply acuminate and base very oblique, always acute on one side; sec. n. 8–16. Petiolule ·25–·4″. Diœcious. Panicles (m.) or spikes (f.) axillary or extra-axillary and shorter than the leaves, sometimes 2-nate. Calyx 5-partite, lobes obtuse. Pet. 3. Anths. 6. Ovary 3-celled. Seeds with scarlet arillus, subglobose or oblong polished chestnut coloured with a white linear raphe, apiculate or ridged one or both ends, ·5–·7″ without the aril.

The seeds are frequently 2-embryous, both embryos germinating. First leaves simple or with one additional lflt. The name *Rohituka* is Sanscrit. Seeds yield a medicinal oil.

2. **A. spectabilis,** *Miq.* (*vide Kew Bulletin*, No. 7, 1920). Syn. A. Wallichii, *King*; Sphærosacme rohituka, *Wall. Herb.* (in part); Karandali, *Or.*

A tall handsome tree with considerable trunk and a high crown. Sap of young parts milky. L. crowded at the ends of the twigs 15" to 3 ft. long with a stout rhachis. Lflts. opp. or sub-opposite 9–19 (or sometimes close to the panicle only 3–7), terminal usually elliptic, lateral oblong, or basal ones ovate and reflexed. Fls. diœcious (or according to *King*, polygamous). Males in panicles 9–22" long from the upper axils. St. tube subglobose crenate with 8–9, rarely 10 half-exserted anthers. Fem. panicles sub-racemose, 2·5–4", stout, with flowers on stout pedicels 3–4-merous. Capsule subglobose, 2" diam., 3–4-celled with milky juice when unripe, tomentose. Seeds with scarlet aril and chestnut-coloured testa.

Mountain valleys of Singbhum! Mayurbhanj! and Orissa!

Fls. July–Nov. Fr. May–June. Evergreen.

Bark smooth pale. Blaze rather soft, streaked with brown and cream and exuding drop of milky juice. Twigs and leaf rhachis grey or rusty with microscopic fimbriate scales or stellate hairs, young brown tomentose. Lflts. decreasing in size towards the base of the leaf, 6–14" long or basal only 3–4", acute or acuminate with regular or somewhat oblique rounded or obtuse base and 13–20 strong spreading sec. n. Petiolules ·7" or of terminal leaflet 1–1·5". Ovary depressed yellow tomentose 3-gonous, stigma very large 3-lobed.

The tree yields a useful timber which is used for planking. It is red in colour. It should be preserved and propagated in evergreen forests.

12. AGLAIA, *Lour.*

Trees or shrubs often lepidote with 3-foliolate or odd-pinnate leaves and entire leaflets. Flowers polygamous. Calyx, corolla and andrœcium all 5-merous, rarely anthers 10, staminal tube subglobose entire or 5-toothed at apex. Disc very small. Ovary 1–3-celled. Fruit indehiscent, 1–2-celled and -seeded. Seeds with fleshy integument.

Leaflets 6–9" long. Panicles 2–4". Anthers 10 . . . . 1. *Haslettiana.*
Leaflets 3–5·5" long. Panicles 5". Anthers 5 . . . . 2. *Roxburghiana.*

1. **Aglaia Haslettiana,** *Haines* (*Journ. As. Soc.*, xv, 7).

An evergreen tree up to 4 ft. girth with brown scaly shoots, rather distant impari- or pari-pinnate leaves with 5–7 large oblong shortly abruptly acuminate leaflets 6–9" long and axillary panicles of small globose very fragrant flowers ·15" diam. Calyx broadly campanulate, scaly. St. tube as long as petals, globose, with scarcely toothed mouth. Anths. 10, 1-seriate equal sessile, included, on ridges formed by the equal adnate filaments.

Evergreen forest near nalas. Mals of Puri! Angul!

Fls. April–May. Fr. not seen.

Shoots, petioles and rhachis lepidote. L. rhachis 8–10" long. Lflts. sub-opp. or mostly alternate, larger 1·8–3" wide, base tapering and oblique, young densely lepidote beneath, glabrescent except for a few scales on the midrib, sec. n. strong, 10–15, incurved within the margin, tertiaries very obscure. Petiolule ·2–·4". Panicles 2–4" closely lepidote shortly peduncled. Pedicels ·05–·1". Calyx shallowly toothed.

Pet. 5 ell.-oblong, tip rounded. Mouth of the staminal tube crenulate. Anths. oblong. Disc. 0. Ovary short, somewhat 3 angled. Stigma sessile 3-lobed.
This species unites *Aglaia* and *Amoora*. The fruit is required.

2. **A. Roxburghiana,** *Miq.*

A tree or shrub with leaves 3–10″ long, leaflets 5, rarely 6–7, 1·5–5·5″ long, narrowly elliptic or ell.-lanceolate, obtuse or acute, glabrescent. Flowers under ·1″ diam., yellow, in elongate supra-axillary pyramidal tomentose and slightly scaly panicles as long as the leaves. Fruit subglobose, ·75″ diam., rusty lepidote and velvety.

Very rare. Hill east of Pitorea (Ranchi), *Wood*! Baruni Hill (Puri), *Gamble*! Fls. Nov.-Dec. Fr. June.
Lflts. in the Ranchi specimen oblanceolate and only up to 4″ long. Sec. n. 10–13, not reaching margin nor curved within it. Fls. sessile or pedicelled, calyx often stellately scaly, petals oblong.
The seeds have a white edible aril.

13. CARAPA, *Aubl.*

Littoral trees with paripinnate leaves and 1–3-jugate leaflets. Fls. in lax axillary panicles, 2-sexual, 4-merous. St. tube globosely urceolate, 8-toothed with 2-partite teeth. Anthers 8 included, sessile alternating with the teeth. Disc cupular adnate to base of ovary. Ovary 4-grooved, 4-celled, with 2–8 ovules in each cell. Style short, stigma discoid. Fruit very large subglobose with fleshy or coriaceous pericarp, 6–12-seeded, finally 1-celled by complete or partial absorption of the septa, loculicidally 4-valved. Seeds large, thick, irregularly angular and compressed. Aril ?.* Hilum large. Alb. 0.

1. **C. obovata,** *Bl.* Dhundul, *Beng.*; Susambar, *Or.*

A small tree. L. with 1–2 prs. of glabrous rather coriaceous, oblong or ell.-oblong leaflets 2·5–4·5″ long. Fls. small yellowish, in panicles 1–2·5″ long. Conspicuous in fruit by the large globose or oval fruit 3–4″ long.

Tidal Swamps of Mahanadi delta! Fls. r.s. Fr. April–May.
Bark smooth, that of twigs pale. Blaze pink. Lflts. rounded at tip, somewhat tapering at base into a brown petiolule; sec. n. very fine, 8–10, soon finely reticulate. Fls. ·17–·2″ long. Seeds ·8–1·3″, yellowish, with a thick orange coloured aril.*
The fruit is largely collected. It is said to be a cure for swellings of the breast and elephantiasis. *Brandis* says it attains 7–10 inches.

FAM. 41. ICACINACEÆ.

Trees or shrubs, often climbing, with alternate very rarely opposite, usually entire, sometimes lobed or toothed, exstipulate leaves. Flowers 4–5-merous, regular, usually small and in cymose panicles, or in axillary clusters, spikes or racemes, 1–2-sexual with perianth single or double. Calyx small, not enlarged in fruit. Petals 5, rarely 4, usually free valvate or narrowly imbricate, the apex usually bent inwards, then erect and finally deciduous. Stamens *isomerous and alternate* to the petals, reduced to staminodes in the female, sometimes bearded below the anther, which is 4-celled with introrse or

* The aril is described as absent in all works of reference consulted, but my notes state that an aril is present. It possibly disappears when the fruit is quite ripe.

lateral dehiscence. Disc absent or cupular or lobed. Carpels usually 3, sometimes 2 or 5, united into an ovary which is usually 1-celled above, rarely completely 3- or 5-celled. Ovules 2 to each cell, collateral, pendulous from the top of the partition, anatropous, micropyle superior and interior. Stigma 2–5 lobed or capitate. Fruit usually drupaceous. Seed pendulous with thin coriaceous testa, usually albuminous. Embryo straight or bent with superior radicle and variously sized cotyledons.

1. NATSIATUM, *Ham.*

Climber with alt. palmi-nerved leaves and diœcious flowers in axillary racemes. M. fl. sepals 5 connate below, open in bud. Pet. 5. St. 5 (4–6), anthers with large pointed connective and adnate cells, inserted inside the disc. Disc small yellow fleshy 10-lobed, and with 10 linear erect glands from the inner surface of the lobes. F. fl. as in M. but stamens reduced to staminodes. Ovary villous, style short, 2–3-lobed. Ovules 2, raphe dorsal. Drupe obliquely ovoid, compressed. Seed 1, alb. fleshy, cotyledons orbicular 3–5-nerved.

1. **N. herpeticum,** *Ham.*

A strong twiner with pallid almost white stems attaining 1″ diam., alt. cordate-ovate dark green palmately 7–9-nerved dentate or denticulate long-petioled leaves, larger 6–7″ by 4–5″, and small drooping greenish-yellow villose urceolate flowers in long slender pendulous axillary or supra-axillary simple or compound racemes 4–9″ long. Fruit an obliquely ovoid 1-celled compressed drupe ·25″ long.

In the moister forests, chiefly near nalas, rather rare. Puri Mals (Rajim)! Angul (Bolong and Raigoda forests)! Common in Purneah! Fls. Jan.–March. Fr. March–April. New leaves March.

Wood with groups of large pores and inconspicuous medullary rays. Branches strigose, youngest shoots densely yellow hirsute. L. glabrescent above but slightly scabrous, beneath permanently hirtellous, tip acuminate sometimes with the central nerve excurrent, margin repand or sinuate with mucronate teeth; sec. and tertiary nerves very irregular. Peti. 2–5″ often coiled. Fls. ·2″ diam. Buds ovoid acute densely strigose. Calyx deeply (4–) 5-lobed, lobes spreading scabrid. Pet. 5 lanceolate or oblanceolate longer than the sepals, free or nearly so, flat recurved valvate. M. fl. fil. very short, anthers yellow incurved, pistil rudimentary. F. fl. style very short with 2 linear diverging lobes.

FAM. 42. OLACACEÆ.

Shrubs or trees, more rarely undershrubs with alternate simple entire exstipulate leaves and small regular usually 2-sexual flowers in spikes, racemes or cymes, usually axillary. "Calyx" small, toothed or reduced to a rim which may enlarge in fruit and envelop it. Tepals 4–6, free or connate, valvate, rarely imbricate. Stamens rarely isomerous, usually two to three times as many and opposite to the petals, some sometimes reduced to staminodes, anthers ovate or linear longitudinally dehiscent. Ovary free or more or less sunk in the torus, 2–5-celled at the base only rarely also above, usually with a free central placenta from which 1 (very rarely 2) slender anatropous ovules hang in each cell, micropyle superior and interior.

occasionally ovary 1-celled with 1 pendulous or erect ovule. Style with small stigma. Fruit usually drupaceous and 1-seeded, the placenta usually sunk in a cleft of the seed which has a thin testa and copious albumen. Embryo small apical.

The family is allied to the *Santalaceæ* and *Loranthaceæ*, and is only introduced here in order to adhere as closely as possible to the order of the families in the *Genera Plantarum* and *F.B.I.*, *vide* Introduction. The morphology of the "calyx" is doubtful.

A. Stamens two or three times as many as the petals. Ovary with
 2 or more ovules . . . . 1. *Olax.*
B. Stamens as many as petals or corolla lobes. Ovary 1-ovuled.
 Fls. pedicelled. Petals free . . . . 2. *Opilia.*
 Fls. sessile. Corolla 4-lobed . . . . 3. *Cansjera.*

1. OLAX, *L.*

Shrubs or undershrubs, sometimes scandent and spiny with alt. leaves. Fls. in axillary racemes or panicles with inconspicuous bracts. Perianth of a minute outer calyciform rim accrescent in fruit and 3–6 free or more or less connate tepals. St. 9–12, occasionally fewer, usually only 3 fertile, fertile stamens usually opposite to and attached to the edges and staminodes opposite the centres of the tepals. Anthers oblong 2-celled and filaments free. Ovary superior, usually 3-celled below and 1-celled above, style simple, stigma 3-lobed. Ovules 3 pendulous from the axis, two soon abortive. Fruit drupaceous surrounded by the accrescent outer perianth. Embryo minute apical in fleshy albumen.

The fertile ovule pushes the central placenta to one side, so that the latter appears as an ascending basal funicle in fruit.

1. **O. scandens,** *Roxb.* Rimil, Rimilbiri, *K.*; Hund, *S.*; Koko aru, *Beng.*; Bader, Badalia, Badurli, Bhadbhadia, *Or.*

A large usually scandent shrub with trunk attaining 1 ft. diam., pubescent branchlets and white flowers ·25–·3″ long in short axillary racemes. Fruit yellow fleshy sub-globose, ·3″ diam., more than half enclosed in the accrescent outer perianth.

Common from Bettiah to Puri and Kalahandi, *i.e.* throughout the whole province! Fls. April–June. Fr. Oct.–Dec. Evergreen.

Rarely spinose. L. patent, attaining 3 by 1·5″, rarely 4·5 by 1·75″, often less than 1″ on the same branch, orbicular elliptic oblong or ovate with rounded base, apex obtuse or rounded, pubescent beneath. Sec. n. slender 4–7, scarcely distinguishable from shorter intermediate, not raised. Petiole ·3–·5″, pubescent. Fls. often distichous, sometimes panicled from leaf suppression, pedicels short. "Calyx" ciliate. Tepals narrow, ·2–·3″. St. 7–10, 3–5 fertile, staminodes 2-fid. Disc thin, cupular.

The fruit is eaten. It is insipid and somewhat viscous. A sherbet is made from it in Hazaribagh.

2. **O. nana,** *Wall.*

A suffruticose perennial with a woody rootstock, sending up annually erect strict herbaceous shoots 1–2 ft. high with sub-sessile oblong-lanceolate or linear-oblong leaves and solitary axillary small white flowers.

Usually in grass lands. Northern tract, near the Nepal frontier! Central tract, Neterhat plateau! Manbhum, *Campbell.* Fls., Fr. April–June.

Shoots striate. L. glabrous, reaching 3″ by ·5–·75″, obtuse. Peduncles ·5″ long. Fls. ·3″, white when expanded, buds oblong. "Calyx" rudimentary in flower, accrescent and enclosing the fruit with a fleshy scarlet coat. Petals 3, linear-oblong. Fertile stamens 3, staminodes 3, white 2-fid. Fruit (with coat) ·5″ diam., oblong or obovoid.

2. OPILIA, *Roxb.*

Shrubs, usually scandent with alt. penninerved leaves sometimes showing translucent dots. Fls. small fascicled on the rhachis of axillary racemes with large deciduous bracts concealing the flowers in bud. "Calyx" nearly obsolete annular. Tepals 5. Filaments 5 opp., the tepals very slender alternating with 5 fleshy disc glands or staminodes. Ovary superior 1-celled. Style short, stigma minute. Ovule solitary pendulous. Fruit drupaceous. Albumen fleshy. Embryo apical or axial.

1. **O. amentacea,** *Roxb.* Kara Badalia, Duraikuli, *Or.*

Usually scandent with fulvous-tomentose branchlets and sub-coriaceous lanceolate or lanc.-ovate mostly acuminate leaves 1·5–4″ long with usually 5–8 distinct (or indistinct when fresh) fine and irregular sec. nerves. Fls. very small, greenish, slender-pedicelled, in threes concealed in bud by orbicular rhomboid ciliate bracts which are arranged in catkin-like axillary and extra-axillary spikes ·75–1·5″ long.

Sambalpur! Angul, very common on the gneiss and sandstones of the Durgapur range! Singbhum, rare! Santal Parganas, *Gamble.* Fls. April–May. Fr. July. Evergreen.

L. with small raised dots when dry, tertiary nerves usually distinct. Petiole ·1–·15″. Racemes solitary or clustered, rhachis tomentose. Pedicels ·15″. Tepals yellowish or green. Anths. versatile. Drupe ·3″, pedicelled.

A root parasite, *Barber.*

3. CANSJERA, *Juss.*

Sarmentose or climbing sometimes spiny shrubs with alt. shortly-petioled penninerved leaves sometimes showing translucent markings. Fls. small, 2- or functionally 1-sexual in axillary spikes with inconspicuous bracts. Perianth campanulate, tepals 4–5 valvate. St. isostemonous hypogynous inserted on the broad torus opposite the tepals outside of and alternate with large disc glands or staminodes. Anthers small oblong 2-celled sometimes adherent by the connective to the perianth, dehiscence longitudinal, filaments free or slightly adnate to base of perianth. Ovary superior 1-celled, stigma capitate lobed, lobes alternate with stamens. Ovule solitary pendulous. Frt. drupaceous surrounded by the marcescent perianth. Embryo in the upper part of the fleshy albumen, cotyledons 2 deeply bifid (or 4?) or 3 (according to Griffiths).*

1. **C. Rheedii,** *Gmel.* Jhantika, *Or.* Also Badalia, etc., from confusion with *Olax scandens.*

A large suberect or usually scandent shrub with generally spiny stems and green spinous or unarmed branches with a minute curly

* I thought in one case that I had confirmed Griffiths' observation, but found the third cotyledon easily separable into 2, or perhaps 2 segments.

pubescence on the younger twigs. L. 1·5–3″ patent ovate to lanceolate acuminate shining both sides but with a somewhat wrinkled appearance. Fls. sessile, ·1″, green or yellowish pubescent with 4 rarely 5 very short recurved broadly triangular lobes. Drupe ·3–·5″ scarlet ellipsoid with thin hard endocarp.

Widely distributed but not usually common, mostly along ravines and near water. Champaran (Sameshwar Hills)! Central tract: Gaya ghats! Monghyr! and Santal Parganas! Southern tract: Singbhum! Puri, more frequent! Fls. Nov.-Dec. Fr. March-May.

Old trunks with large blunt spines and mottled with white lenticels, spines on the young stems and branches often slender, ·5–1·2″ long. Twigs sometimes ferruginous-pubescent. L. occasionally 4·5″ long, nearly opaque but with faint translucent nerves and dashes, young puberulous; sec. n. 3–4, rarely 5 or 6, 1–2 quite close to the often oblique usually rounded base, tertiaries very indistinct. Peti. ·05–·15″, articulate at base. Spikes ·4–1″ long, 1–2-nate, sub-tomentose. Bracts minute subulate persistent. Ovary or pistillode narrow-oblong. Stigma slightly exserted.

NOTE.—A root parasite (vide *C. A. Barber* in *Memoirs of the Department of Agriculture in India*, Bot. Series, vol. ii, part 5). The ovaries often contain no ovule and a single fruit at the end of the peduncle is common. The broad torus sometimes extends beyond the perianth into a minute annulus which may be homologous with the "calyculus" of *Olax*. Embryo 2 mm. long with a very broad fleshy hypocotyl and 4 flat oblong cotyledons.

FAM. 43. ILICACEÆ.

Trees or shrubs with alternate usually coriaceous and evergreen or nearly evergreen leaves, stipules 0 or minute. Flowers regular, usually diœcious, small in axillary cymes, fascicles or umbels. Calyx 3–6-partite or lobed imbricate persistent. Petals 4–5, rarely 6–8, connate at the base or free in the female, imbricate in bud. Stamens isomerous, adhering to base of petals or free hypogynous, filaments subulate anthers shortly oblong dorsifixed. Disc 0. Ovary free or imperfect in male, 3–16-celled; style short or 0, stigmas free or united capitate or discoid; ovules 1 or 2 collateral, pendulous with dorsal raphe and superior micropyle, funicle often cupular. Fruit a drupe with two or more 1-seeded pyrenes. Albumen fleshy, embryo minute.

1. ILEX, *L.*

Fls. 4–5-merous. Corolla rotate. Stigmas free or confluent.

1. **I. umbellulata,** *Loes.* Syn. I. Godajam, *Colebr.* Marcha, *Th.*

A small tree with pubescent twigs and simple elliptic or ovate-oblong rather coriaceous glossy leaves 3–5″ long, when in flower young and often membranous. Fls. small, ·18″ diam., white or yellowish, crowded together in small umbels ·3–·4″ diam. on slender peduncles which arise from the lower axils or from the axils of deciduous bud scales below the leaves.

Forests of Northern Champaran! Fls. March-May with new leaves. Fr. May-June.

Distrib. along the foot of the Himalaya eastwards to Chittagong and Burma.

Attains 3–4 ft. girth. Bark nearly smooth. Blaze with chlorophyll in outer layer, then red. L. glabrous when old except on nerves beneath, shortly bluntly acuminate, base often cuneate and somewhat decurrent on the ·5–·7″ long pubescent petiole, sec. n. about 6–7, fine spreading, rather irregular looping some

distance from margin, which is slightly thickened. Stipules 0. Fls. polygamous. Peduncles ·5–·8″ long. Pedicels ·15″ with triangular bracts at their base. Sepals orbicular. Petals usually 5 ovate-oblong rounded, connate below. Fr. ovoid-oblong, ·15″, with 5 (4–6) pyrenes, tipped with the short style and stigma, sulcate when dry.

NOTE.—A small tree with drooping branches and oblong leaves, 4–9·5″, membranous, very glossy above, base narrowed to a stout usually curved and rusty petiole ·5–·6″ long, sec. n. 7–8, found in the Ramnagar forests, was also probably this species.

FAM. 44. CELASTRACEÆ.

Usually glabrous, often thorny trees or shrubs, sometimes climbing, with simple opp. or alternate coriaceous leaves usually with small stipules. Fls. usually white or greenish, small, rarely terminal, in axillary cymes more rarely clustered or racemose and panicled, regular, 2–1-sexual. Calyx small with 4–5 sepals sometimes connate at base. Petals 4–5 usually imbricate in bud. Disc well-developed, thin and spreading or pulvinate, entire or lobed. Stamens 4–5 alternating with the petals, inserted on or under the margin of the disc; filaments short subulate with oval or ovate anthers attached dorsally. Ovary sessile free on the disc or immersed in it, superior very rarely half-inferior, 2–5-celled or (in the anomalous genus *Siphonodon*) with very numerous irregular cells. Style short, stigma capitate or lobed, sometimes very small. Ovules usually 2 in each cell, rarely 1 or more than 2, erect from the axis, rarely pendulous (if 1 only). Fruit loculicidal or drupaceous or baccate. Seeds usually enclosed in a bright-coloured aril, sometimes winged, usually albuminous. Embryo axile with large usually green cotyledons and short radicle.

I. Ovary cells 3–5. Ovules 2 in each cell.
  a. L. opposite. Fr. capsular . . . . 1. *Euonymus.*
  b. L. alternate. Fr. capsular.
    Fls. cymose. Ovary sunk in the disc . . . . . 2. *Gymnosporia.*
    Fls. racemose or panicled. Ovary free . . . . . 3. *Celastrus.*
  c. L. opp. or sub-opp. Fr. drupaceous . . . . . . 4. *Elæodendron.*
II. Ovary cells divided up into many cellules each containing 1 ovule.
  L. alt., fls. cymose. Fr. sub-baccate . . . . . . 5. *Siphonodon.*

1. EUONYMUS, *L.*

Trees or shrubs with glabrous opposite leaves and caducous stipules. Fls. mostly in 2–3-chotomous cymes. Disc large fleshy 4–5-lobed. Ovary more or less sunk in the disc 3–5-celled. Stigma 3–5-lobed. Ovules 2 in each cell, one ascending sub-basal, the other on the axis, rarely more than 2. Capsule 3–5-celled and -lobed, angled or winged, coriaceous.

1. E. glaber, *Roxb.*

A small dark-foliaged tree with coriaceous shining ell., ell.-oblong or oblong-oblanceolate shortly acuminate entire or serrate leaves 2–4″ long and greenish-white 5-merous flowers ·3″–·4″ diam. in dichotomous long-peduncled more or less twelve-flowered opposite cymes

usually on abbreviated shoots from the axils of the leaves or from the axils of leaf scars on the older branches.

Mayurbhanj: Simlipahar Mountains, chiefly along streams, above 2000 ft.! Fls. May. Fr. not seen. Evergreen.

Attains 3–4 ft. girth. Bark light, nearly smooth. Blaze white then deep crimson. L. sometimes obovate and attaining 4·5″ by 2·5″ in exceptional cases, shining both sides, quite glabrous, usually serrate in the upper half and with acute entire base; sec. n. very fine oblique and arched, about 5, with shorter intermediate, others inconspicuous. Petiole ·25–·3″. Stipules small glabrous with brown hairy or fimbriate tips. Cymes sometimes apparently terminal in which case single and a new shoot springs from its side, usually from the axils of leaf scales on new shoots or special abbreviated branchlets, rarely only 5–7-fld., sometimes 2″ broad and 15-fld. with slender divaricate branches. Peduncles 1–1·5″. Pedicels articulate ·2–·5″. Bracts minute lanceolate ciliate. Calyx sub-petaloid, sep. orbicular. Pet. twice as long, sub-orbicular ·12″, short-clawed, minutely denticulate. St. at the edge of the large conical 5-angled disc. Anths. very short. Ovary 5-celled right to its conical top, not deeply sunk in the disc. Ovules 2 in each cell, one sub-basal one axile. Capsule, ?

2. GYMNOSPORIA, *W. & A.*

Shrubs or small trees usually thorny with alternate exstipulate leaves and axillary often clustered dichotomous cymes of small flowers; cymes often much contracted so that the flowers appear clustered. Disc broad sinuate or lobed. Ovary more or less sunk in the disc, 2–3-celled with short style and 2–3 stigmas. Ovules 2 in each cell. Capsule usually obovoid. Aril partially or entirely covering the seed or 0.

a. L. coriaceous orbicular or obovate.
  L. entire. Cymes contracted with long pedicels . . . 1. *emarginata.*
  L. crenulate. Cymes divaricate, not contracted . . . 2. *montana.*
b. L. lanceolate acuminate or ovately-elliptic . . . . 3. *rufa.*

1. G. emarginata, *Roth.* Bali bhains, Boincha, *Or.* (from confusion with *Flacourtia*).

A rigid dense shrub unarmed or usually with long straight sharp thorns attaining 2–3 inches and leaves somewhat like that of a *Berberis*, entire very coriaceous or fleshy mostly obovate 1–2″ long. Greenish-white flowers about ·2″ diam. with long slender pedicels densely clustered in very short cymes mostly on short branchlets in the axil of a thorn.

Puri, from the Khandgiri sandstones in the north to the shores of the Chilka Lake (among rocks) in the south!
Fls. Nov.–Dec. Fr. Jan.–March.

Sometimes only 3–4 ft. Branches sometimes zigzag. Bark pale grey. L. attain 2–3″, rarely broadly elliptic or ovate, usually with rounded tip and cuneate base, tip occasionally retuse, pale beneath; sec. n. about 3, green, scarcely raised, very reticulate between and at margins. Petiole ·1″. Lower cymes often borne on the thorns, opposite, only 3-fld. or once or twice 2–3-chotomously branched, subsessile with minute brown fimbriate bracts, uppermost axillary often only 2–3-fld. and subsolitary. Pedicels ·3–·5″. Fls. polygamous. Sep. minutely ciliate. Pet. 2–3 times as long, ·1″ oblong. St. from beneath the pulvinate disc, longer in the male than in herm. fl. Ovary in the m. small and sunk in the disc with 3 sessile stigmas; in fem. and herm. fls. exserted with conspicuous style and 3 oblong stigmas. Capsule coriaceous ·3″, 3-gonous, pyriform, split about four-fifths to base when ripe into 3 valves. Young seeds with a rudimentary lobed collar-like aril, 1–2 in each cell, ripe shining brown or reddish, ·07–·1″ diam., aril spreading and finally deciduous.

(The flowers in both *F.B.I.* and *Bengal Plants* are referred to as "fascicled" in contra-distinction to those of *G. montana*, which are spoken of as "cymose," but

this distinction does not hold if it implies that the fls. of this species are not cymose.)

2. **G. montana,** *Benth.*

A large shrub with the branchlets mostly ending in thorns which often bear leaves and flowers. L. coriaceous grey-green especially when dry, 1·5–2·5″ obovate oblanceolate elliptic or orbicular but always with cuneate base tapering into the ·25–·4″ long petiole, and rounded or retuse at the apex, minutely crenulate. Fls. white ·2″ diam. in numerous lateral 2–3-chotomous cymes ·4–1″ long. Fruit coriaceous sub-globose ·2″ diam., usually purple when ripe.

Behar, *Kurz.*! not common; Parasnath, *Anders.*, but the specimen has no inflorescence and leaves not at all typical; it is somewhat doubtful. Fls., Fr. Oct.-Dec. Evergreen.

L. with 6–10 sec. n., very fine, but more visible than in *emarginata*. Capsule mostly 2-valved. Seeds 1 or 2, rarely 3, with a thin aril or aril absent.

3. **G. rufa,** *Wall.* Var. latifolia, *Haines.*

A large shrub or small tree with sharp (axillary) thorns on many of the branches, glabrous elliptic or ovately elliptic crenulate leaves 3–4·5″ long, obtuse or bluntly acuminate and mostly with acute base. Fls. in axillary sessile, dichotomous or panicled cymes, often several from a bracteate tubercle. Capsules 3-gonous, ·25″ diam.

Ravines in the Sameshwar Hills! Fl. March–April* (*f.* Wallich). Fr. Nov.-Dec.

Shoots papillosely pubescent. Thorns ·3″ only or 1·5–2″ on the same plant. L. sometimes 2·25″ wide with about 7–10 fine sec. n. and other intermediate nerves, very finely but inconspicuously reticulate between, crenatures sometimes obscure, when young apiculate and then serrulate rather than crenate. Petiole ·2–·25″, often pink, minutely pubescent, base of leaf decurrent on the sides as ridges. Stipules deciduous exceeding the petiole lanceolate, ending in a long villous tip. Cymes about 1″ or when panicled up to 2·5″, minutely pubescent, bracts at the forks minute lanceolate acuminate. Sep. 5, very small, broadly triangular persistent. Pet.* ·08″, suborbicular-ovate with very broad base, venose. St. 5 at edge of disc. Ovules 2 in each cell from near the base. Capsule ·3″ long, coriaceous, valves splitting about three-fourths of the way down. Young seeds with a collar-like aril (it probably grows up in older seeds).

NOTE.—Most of the specimens of *G. rufa* in Herbaria and Wallich's types have linear-lanceolate leaves or narrowly ell.-lanceolate and very capillary peduncles to the cymes, when in flower attaining 2″ long, though often much shorter and invariably glabrous. Wallich says leaves lanceolate, acuminate serrulate. Corymbs axillary capillary on capillary reddish coloured peduncles. Young branches of a more or less deep red colour, glaucous.

3. CELASTRUS, *L.*

Scandent shrubs with alternate usually serrate leaves. Fls. polygamous, in terminal or axillary panicled cymes, or racemes, 5-merous (exc. the pistil). Disc broad concave 5-lobed. Ovary not immersed in the disc, 2–4 mostly 3-celled, stigma 3-lobed or 3-fid. Ovules 2 erect in each cell. Capsule usually coriaceous. Seeds enclosed in a fleshy aril; albumen fleshy. Embryo erect.

1. **C. paniculata,** *Willd.* Kujri, *K.*, *S.*; Konjri, *Kharw.*; Malkamni, Malkangni, *H.*; Maltangun, *Th.*; Peng, Korsana, *Or.*; Chiron, *Mal. Pah.*

A scrambling or climbing shrub with long lenticellate branches,

* Fls. described from dried remains which could not have been older than September.

obovate serrulate leaves 1·5–5″ long by 1–2·5″ broad, green flowers ·12″ diam. in terminal panicled cymes and yellow 3-lobed capsules ·3″ long with red-arilled seeds.

Very common in hedges, in all districts! Fls. April–June with the new leaves. Fr. Oct.–Jan.

L. sometimes ell. or oblong, always with a short sudden acumination, young (and young branchlets) pubescent and bright green, base acute, sec. n. slender 4–7, petiole ·25–·5″, stipules minute deciduous. Panicles 2–6″, lanceolar, with minute bracts. Sepals orbicular, erose. Petals ovate-oblong obtuse. Capsule globose or obovoid 3-valved, 3–6-seeded.

From the seeds are obtained two valuable oils by expression and by distillation respectively. The fixed oil is used for burning as well as for external use in rheumatism, but is not considered so valuable as that obtained by distillation, the so-called *Oleum nigrum*, which is used medicinally.

The fruit is sometimes eaten before it is ripe.

4. ELÆODENDRON, *Jacq. f.*

Small trees or shrubs with opp., sub-opp., or, on some shoots, alternate, entire or crenate leaves and white green or brown flowers in axillary dichotomous cymes, often polygamous, 4–5-merous. Stamens inserted on and near the margin of the large often lobed disc, anthers sub-globose. Ovary conical, base confluent with the disc, 2–4- (usually 2- in our species) rarely 5-celled, ovules 2 linear in each cell. Fruit a drupe with one exarillate seed.

1. **E. glaucum,** *Pers.* Miri, *K.*; Niuri, *S.*; Raj jehul, *Beng.*; Ratan gurur, *Ghatw.*; Geti, Mutowar, *Th.*

A small tree with crenate or serrulate rarely (Ramnagar) coarsely crenate-serrate leaves usually about 5″ by 2·5″ and lateral corymbose cymes of small greenish-white or brownish flowers succeeded by nearly dry oblong or obovoid drupes ·5″ long.

Throughout the whole area from the Ramnagar Hills to Puri, commonest in the central tract. Fls. Sept.–Dec., but also (*teste Brandis & Cooke*) Feb.–Aug. The fruits may be found at most times of the year and appear to ripen about Feb. Evergreen, or nearly leafless March–April.

Bark grey, nearly smooth, thin. Blaze rather hard with dark red outer layer or (in old trees) thick red-brown outer layer, then whitish and reddish on the wood. The cut is followed almost immediately by a flow of water from the lower edge. L. deep green glabrous, 2–6″ by 1–3″, ovate to obovate, acute or acuminate nerves slender. Peti. ·5–1″, cymes 2–4″, peduncles long. Sep. unequal orbicular. Pet. ·15″, oblong (from lower part of margin being recurved), dorsally pubescent. St. on the lobes of the disc, straight ascending, finally spreading and recurved (probably proterandrous).

A preparation of the bark is given in cholera (*Camp.*).

5. SIPHONODON, *Griff.**

Tree with alternate leaves. Fls. in 3–several-fld. divaricate cymes axillary and from the old wood, 5-merous. Calyx with rounded sepals. Petals on the disc broad-oblong. Disc filling the calyx tube with a lobed margin. Filaments broad, inserted between the disc lobes, flattened, arching over the pistil, anthers with very broad connective bearing the oblique laterally dehiscing cells on the margin. Ovary at first inferior, subsequently half-superior consisting of a whorl of some 20–30 cells radially disposed, finally irregularly

* For an account of the remarkable structure of the pistil in this genus, *vide* Hooker, *Trans. Linn. Soc.* xxii, p. 133.

2–3-seriate, each cell with one ovule horizontal or inclined upwards or downwards, with lateral raphe. Style annular with five minute stigmatic appendages opposite to the petals (there are also five smaller points alternating with these, not noticed in the article quoted on p. 189). From the centre of the annulus rises what looks like a stout style and capitate stigma; its use is unknown (its tissue is non-conducting). Fruit with coriaceous pericarp, firm fleshy mesocarp and numerous irregularly arranged radially compressed woody pyrenes. Testa very thin. Cotyledons large, thick; caulicle directed towards the axis.

The ovary may be looked upon as morphologically 5-celled, each cell separated between the ovules by secondary partitions and becoming irregularly displaced by growth.

1. **S. celastrineus,** *Griff.*

A small erect glabrous tree with coriaceous somewhat distichous ell.-oblong more or less crenate leaves somewhat resembling those of *Croton oblongifolius,* white flowers ·5–·6″ diam. in 3-fld. or up to 7-fld. cymes mostly from the old wood of branches or trunk. Fruit broadly pyriform, 1·25–2″ long by 1–1·5″.

Ravines in the Rajmahal Hills, not common! Fls. April–June. Fr. ripens Feb. Evergreen.

It occurs in Sikkim and no doubt was found in Purneah before the disforestation of that district.

Bark grey, slightly rough. Blaze thin grey, then yellow, white on the wood. L. 4–8″ by 1·5–3·5″, very shining above, acute or acuminate with rounded rarely acute base, sec. n. slender about 8, depressed above.

FAM. 45. HIPPOCRATEACEÆ.

Usually glabrous and usually climbing* shrubs with simple opposite, rarely alt., often coriaceous leaves without or with small caducous stipules. Fls. usually small, sometimes very small, white, green or yellow, axillary clustered (often on tubercles) or in dichotomous or dichasial cymes, regular. Calyx 5-merous, sepals more or less connate at base. Petals 5 free, larger than the sepals, inserted below the disc. Disc fleshy, sometimes very large and concealing the ovary. St. 3 (rarely 2 or 4) inserted on the inner side of the disc with flattened filaments, usually ultimately recurved. Ovary on or sunk in the disc, 3-celled with 3-lobed stigma. Ovules 2-10 in each cell, sometimes 2-seriate, anatropous. Fruit either of three often vertically compressed almost free dry carpels (samaras) or a berry, rarely a 3-lobed capsule. Seeds winged or not. Albumen 0. Cotyledons large, often nearly fused into one mass.

Erect or scandent. Fr. baccate . . . . 1. *Salacia.*
Scandent. Fruiting carpels samaroid . . . . 2. *Hippocratea.*

1. SALACIA, *L.*

Small trees or (in our area) erect or scandent or sarmentose shrubs with opp. (rarely alternate) entire or toothed leaves, usually exstipulate. Fls. clustered axillary, often on small bracteate tubercles,

* By means of spirally growing twigs.

rarely in cymes. Ovary conical, sunk in the disc, style very short, ovules 2–8 in each cell, 1–2-seriate. Fruit baccate, sometimes sub-woody. Seeds large angular.

1. **S. prinoides,** *DC.*

An erect shrub about 3 ft. high resembling a "*Euonymus*," or scandent, with twigs ridged from the decurrent bases of the deciduous stipules, oblong or elliptic coriaceous faintly crenate-serrate leaves mostly 2–3″ long and clusters of 2–6 yellowish flowers axillary and from leafless axils. Fruit a scarlet globose berry ·5″ with white viscous flesh.

Puri, chiefly in the South! Erect and bushy on the rocky shores of the Chilka Lake but scandent in the forest! Behar, *Prain.* Fls. Dec.–Jan. Fr. April. Evergreen.

Branches pale but small twigs sometimes purple. L. sometimes 3·5″, subacute or shortly tapering to an obtuse tip or rounded, base usually cuneate; sec. n. 6–10 very fine, scarcely visible above. Petiole ·25″. Stipules deciduous. Pedicels ·1–·15″, arising from clusters of minute rounded bracts on very small tubercles. Fls. ·26″ diam. Calyx spreading, ·08″ diam., gamosepalous with deltoid lobes, glabrous. Pet. ·1″ ell.-oblong or appearing obovate and clawed from the inferior margin being reflexed and hyaline, inserted between the disc and calyx. Disc very large pulvinate, ·05″ high and nearly as broad as the calyx, dented at the base opp. the petals. St. 3 inserted on the inner edge at the top of the disc opp. the grooves of the ovary. Fil. flat, finally recurved, anther terminal transverse with 2 oblique cells confluent across the top. Ovary conical, slightly 3-grooved, base only immersed in the disc. Ovules 2 collateral in each cell, axile, horizontal with raphe superior. Style 0. Stigmas minute. Berry usually 1-seeded, sometimes ·7″ diam. and then 2-seeded, on pedicels ·25–·3″ long. Seed light brown subglobose ·3″.

Forma β. Fls. only 1–2 axillary. Pet. ovate and some crenate with cordate base and distinct claw. Scandent shrub, leaves sub-entire.

Mals! Fls. Dec. The shape of the petals corresponds with that described by Lawson (*S. prinoides, DC.*) in *F.B.I.*

2. HIPPOCRATEA, *L.*

Unarmed small trees or climbing shrubs with opposite, often coiled branches sometimes resembling pinnate leaves with opposite spreading often toothed leaves and small three-cornered caducous stipules. Flowers often very small in axillary forked cymes or sometimes terminal and panicled and in scorpioid cymes. Petals coriaceous or thick and fleshy. Ovary seated on the disc or sunk in it, sometimes concealed by the filaments, narrowed into a very short style, ovules 2–10 in each cell, often 2-seriate. Fruit with three winged lobes which are usually dehiscent through their centre and with few vertically compressed winged seeds.

Leaves 1·5–3″ long. Samaras 1–1·5″ . . . . 1. *indica.*
Leaves 3–5·5″ long. Samaras 2–3″ . . . . 2. *arborea.*

1. **H. indica,** *Willd.*

A rambling or scandent shrub climbing by means of its coiled branchlets, with quite glabrous elliptic or somewhat obovate shallowly crenate-serrate leaves 1·5–3·5″, and minute yellow fragrant 5-merous flowers crowded on the branches of axillary and terminal dichasial or 3-chotomous decompound cymes which are ·75–2″ broad. Fruit 1–3 oblong samaras.

Puri, rather common in open jungles (Baghmari; Jaimangal, Kuhuri Hill, etc.)! Behar, *Prain*; Fls. April, Dec.

Twigs either grey or brown, glabrous. L. rarely lanceolate shortly, often bluntly, acuminate with cuneate base, sometimes nearly entire; sec. n. 4–5 very fine curved, reticulate venules impressed, marginal nerve distinct following the serratures. Petiole slender ·2–·3″. Stipules most minute, of 1–3 subulæ, caducous. Cymes broader than long (excluding the ·3–·8″ long peduncles) with subsidiary branches in the axils of the main forks. Bracts linear-lanceolate 1–1·5 mm., decurrent as minute ridges on the branches. Fls. 2·5 mm. diam. Sep. ell. ovate or oblong ovate ·7 mm., papillosely ciliate esp. at base. Pet. 1·5 mm. linear-oblong, margins inflexed when dry. Disc cup-shaped, thin, with a minute free spreading border. Ovary with 3 prominent lobes above the level of the disc with conical tip about as long as the flattened stamens. Samaras oblong 1–1·5″.

2. **H. arborea,** *Roxb.* Damanahar, *Th.*

A very robust rambling shrub with branches at wide intervals, climbing like the last, smaller branches distichous and looking like pinnate leaves bearing usually only 3–4 pairs of leaves 3–5·5″ long, which are oblong smooth shallowly crenate-serrate with short abrupt acumination and rounded or sub-acute base. Minute greenish-yellow 5–6-merous flowers in decompound cymes 1·5–3·5″ broad. Cymes (in my specimen) with numerous bracts on the pedicels. Bracts with black glandular minute deciduous tip and teeth (as in the leaves).

Forests of Ramnagar! Fls. Nov.-Dec. (and possible later). Fr. June-Sept.? (old dropped fruits found in Nov.). "Fls. July. Fr. March," *Roxb.*

Stems attains 2·5 ft. in girth. Wood structure normal. Bark grey, somewhat flaking in squares in old trunks. Blaze pink. L. attain 7″, shining, glabrous, crenatures with deciduous black points; sec. n. 6–8. Petiole ·3–·7″. Cymes as in last but stouter and comparatively fewer-flowered. Bracts lanceolate. Fls. smaller than in last with sub-erect petals 1·2 mm. long. Sep. microscopically crenulate and sometimes with black deciduous tip and teeth, back puberulous. Branches of panicle woody in fruit. Ovary more sunk in the disc than in *H. indica*, very slightly lobed and ovules below level of top of disc, 2 in each cell, axile from near the base (as in *H. indica*). Samaras oblong, 2·25–3″ long and ·7–·8″ wide with cuneate base, brown, with 1–2 ovate seeds at the end.

FAM. 46. RHAMNACEÆ.

Trees or shrubs, often scrambling or climbing, furnished with tendrils in *Gouania* and *Helinus* (and rarely with coiled twigs in *Ventilago*), frequently spinous or prickly. L. simple, alternate, rarely opposite (*Scutia*), frequently basal-nerved. Stipules small, deciduous or changed into prickles. Fls. small, green or yellowish, in axillary cymes or running out into cymose panicles. Calyx 4–5-merous, lobes triangular, valvate, often keeled within. Petals 4–5, rarely 0, inserted on the margin of the disc or on the throat of the calyx-tube (hypanthium), which is usually filled or lined with the disc, usually very small and often hooded over the small stamens, which are always inserted opposite to the petals under or on the margin of the disc, and are hence frequently perigynous. Anthers 2-celled. Ovary free or sunk in the disc, usually superior in fruit, but inferior in tribe *Gouanieæ*, 3-, rarely 2–4-celled. Style short simple, rarely cleft. Ovule 1 in each cell, erect anatropous. Fruit capsular or drupaceous, sometimes winged, 3-, rarely 1–4-celled; albumen fleshy, rarely 0. Embryo large erect.

A. Fruiting calyx hypogynous or perigynous. Tendrils absent.
- 1. Fruit samaroid. Unarmed climbers . . . . . . 1. *Ventilago.*
- 2. Fruit a drupe with a 1-3-celled stone. Erect or climbing, armed with stipular prickles . . . 2. *Zizyphus.*
- 3. Fruit baccate or drupaceous with 2-4 pyrenes.
  - Leaves alternate. Disc usually thin . . . . . 3. *Rhamnus.*
  - Leaves opp. or sub-opposite. Disc usually thick . . . 4. *Scutia.*

B. Fruiting calyx epigynous. Climbing shrubs with tendrils.
- Fls. in paniculate racemes. Fr. 3-winged . . . . . 5. *Gouania.*
- Fls. in peduncled cymes. Fr. drupaceous . . . . . 6. *Helinus.*

1. VENTILAGO, *Gaertn.*

Scrambling or climbing shrubs occasionally with some of the branchlets coiled into woody tendrils or hooks. L. penninerved entire or toothed, sub-bifarious, stipules caducous. Fls. small greenish, 5-merous, 2-sexual, in terminal and axillary panicles. Petals cucullate or conduplicate over the stamens. Anthers short, sometimes shortly horned. Disc filling the calyx-tube below and lining it above, with a short free margin. Ovary sunk in the disc, 2-celled with a short thick 2-fid style which develops in fruit into a large linear or oblong wing above the globose nut.

1. **V. maderaspatana,** *Gaertn.* Bonga-sarjom, *K.*, *S.*; Keonti, *Kharw.*, *Or.*; Petchuri, Pitchule, *Or.*; Pitti, Rai-dhani, *H.*; Rakto-kai (Blood-eater, from the red cracks in the bark), Rairui, Raktapita, *Beng.*

Widely scandent with long sarmentose branches, bifarious elliptic or oblong usually acuminate leaves about 5″ long, young somewhat pubescent, and tomentose or pubescent fascicles of small yellow-green flowers ·12″ diam. arranged in interrupted panicles. The winged fruit is seated on the disc-like calyx.

Throughout the Central and Southern area, chiefly on the edges of forest glades and along streams. Chota Nagpur and Santal Par., frequent! Sambalpur! Mayurbhanj! Orissa! Fls. Sept.–March. Fr. March. Evergreen.

Bark dark grey, furrowed, with red in the furrows. Stems often 2 ft. girth, branchlets puberulous or glabrescent, often pale. L. 3–5·5″ by 1·5–2·5″, sometimes ovate or ovate-lanceolate esp. at base of the twigs, often crenate or crenate-serrate, with 6–8 very slender but distinct sec. nerves and very fine numerous parallel tertiaries. Peti. ·25″. Panicles pubescent. Calyx-lobes shorter than the tube. Petals obovate-spathulate, ·003″ long with produced mid-rib. Disc nearly glabrous or villous. Wing of fruit linear-oblong, 1–2″ long, coriaceous, glabrous.

Bark yields good cordage fibre. The seeds are said to be eaten when cooked and the oil expressed from them is used in cooking. *Campbell* says that the circinate woody tendrils are worn as charms by the Santals.

2. **V. calyculata,** *Tul.* Same vernacular names as the last.

Closely allied to the last and often treated as a variety of that species. The branchlets are more pubescent and the leaves often yellow tomentose, usually much more ovate and obtuse, rarely acuminate, often rounded and fewer secondary nerves (4–5). Panicles densely pubescent. Fls. said by Gamble to be larger than in the last and disc villous. Nut girt to the middle by the calyx-tube and yellow pubescent, wing often ·5″ broad thus becoming oblong, pubescent.

Throughout the area. Bettiah (but the leaves are glabrous and it appears intermediate). Monghyr! Chota Nagpur and Santal Parg., frequent! Angul! and other parts of Orissa, frequent!

Fls. Sept.-Nov. Fr. Feb.-April. Same uses as the last, the Indians not distinguishing the two varieties.

2. ZIZYPHUS, *Juss.*

Small trees or shrubs, sometimes scandent, usually with stipulary solitary or paired prickles; when paired one usually straight and the other hooked. L. sub-bifarious entire or toothed, basal-nerved. Fls. in axillary fascicles or cymes or cymes forming terminal panicles. Calyx 5- rarely 4- or 6-fid, lobes spreading triangular keeled within. Petals very small, ultimately with the stamens reflexed, sometimes 0. Disc more or less filling the calyx-tube and often raised as a cushion above it or with a thin free margin under which the stamens are inserted. Ovary immersed in the disc 2–4-celled. Styles 2–4, free or partially united. Fruit a drupe, sometimes nearly dry, with a 2–3- rarely 1- or 4-celled stone. Albumen scanty or 0.

A. Cymes or fascicles axillary. Petals present.
  1. Erect trees or shrubs.
    a. Peduncles of cymes 0 or shorter than the pedicels. Styles mostly 2 only. Fr. yellow or red.
      Tree. L. densely tomentose beneath. Fr. ·6–1″ . . . 1. *jujuba.*
      Shrub. L. mostly elliptic, tomentose beneath, ·5–1·5″. Fr. ·3″ . . . . var. *fruticosa.*
      Shrub with slender zigzag branches. L. mostly orbicular, grey-tomentose beneath ·3–·7″. Prickles very slender . 2. *nummularia.*
    b. Peduncles mostly longer than the pedicels. Styles 2–4, mostly 3. Fr. green. Tree . . . . . 3. *xylopyra.*
  2. Scramblers or climbers. Styles mostly 2.
      L. silky beneath. Ped. hardly any. Fr. small black . 4. *œnoplia.*
      L. glabrous. Cymes peduncled, forked . . . . 5. *funiculosa.*
B. Cymes panicled. Petals 0. Usually climbing. Fr. white . 6. *rugosa.*

1. **Z. jujuba,** *Lamk.* Janumjan, *K.*; Dodari, *M.*; Dedaori-janum, Jom-janum, *S.*; Dhani, *Kharw.*; Baer, *H.*; Ber, Bar, *Beng.*; Boyer, Baro-koli, *Or.*; Jujube, "Plum" of Anglo-Indians.

A small tree often with drooping branches and oblong or ovate dark green leaves 1·5–3″ long densely tomentose beneath, small green flowers in dense axillary tomentose cymes or fascicles, and yellow or red fleshy drupes ·5–·75″ diam.

Appears indigenous on the Ranchi-Lohardaga ghats! Largely cultivated and self-sown over the rest of the area! Fls. March-Oct. Fr. Jan.-March. Renews leaves March-April.

Attains 2–3 ft. girth with grey or nearly black rough bark. Blaze thin brown then thick dark pink. Twigs tomentose with geminate prickles or often unarmed in old trees. L. with a white or red tomentum beneath glabrous shining above, usually minutely serrulate or apex distinctly toothed obtuse rarely acute with an oblique 3-nerved base. Cymes ·5–·75″ long, sometimes with a short peduncle under ·25″ long. Fls. ·2–·25″ diam. on pedicels longer than the peduncle. Pet. spathulate white concave. Ovary cells 2 and style 2-fid. Fruit globose or in garden varieties ellipsoid, always ellipsoid when very young, stone 2-celled.

The fruit is eaten, it is believed to purify the blood. The bark contains much tannin and is a remedy in diarrhœa and when powdered is used for dressing unhealthy wounds.

Var. **fruticosa,** *Haines.* Janumjan, *Ho.*; Bakura, Bakula, *M.*; Kurit-rama (Vulture's talons), *S.*

A densely branched thorny shrub 3–4 ft. high. L. often symmetrical mostly elliptic ·75–1·5″ long sometimes ovate or suborbicular, minutely serrulate or with 3-more coarse teeth near the apex. Stipular prickles geminate, straight one slender, ·3–·5″ long, the other much shorter, ·15″, stouter, curved. Fr. petioles ·1–·12″. Cymes sessile. Fls. ·18–·25″ diam., rarely 4-merous. Pet. oblong-spathulate concave. Fr. globose yellow or red shining ·3–·5″ diam.

Common and often gregarious in waste places, railway embankments, etc. From N. Champaran to Puri and Sambalpur! Fls. Aug.-Sept. Fr. Nov.-Feb.
It is largely used for fencing. The fruit is eaten but after being dried and pounded is chiefly used for a sherbert in the hot weather.

2. **Z. nummularia,** *W. & A.* Syn. Z. rotundifolia, *Lamk.*; Boyer, *Or.*

A somewhat smaller shrub than the last with more constantly zigzag and more slender branches, leaves mostly orbicular and often retuse only ·5–·75″, mostly white or grey tomentose beneath, sometimes also grey pubescent above, stipular prickles very slender especially the straight one often ·6″ (though sometimes the prickles of *fruticosa* are as slender). Fls. ·14″ diam. Petals very broadly spathulate, lateral margins very slightly inflexed. Fr. ·3″ diam. This is also said to differ from the last by the 10-lobed disc being pitted opposite each lobe whereas that of *Z. jujuba* is grooved. (I have not been able to confirm this character.)

On cotton soil, western Angul and Athmallik! Fls. Oct.-Dec. Fr. Nov.-Feb.

3. **Z. xylopyra,** *Willd.* Karkat, karkata, *K.*, *S.*; Kankor, *Kharw.*; Ghatali, *Khond*; Kat-ber, *H.*; Ghont, *Mal P.*; Ghot, Ghonto, *Or.*; Goit, *Bhumij.*

A small usually straggling and thorny tree or old trees nearly thornless, with broadly elliptic or ovate leaves 1·5–3″ long more or less pubescent or hairy beneath, sometimes woolly when young. Fls. ·18–·2″ diam., green, in axillary peduncled cymes ·5–2″ long in the axils of the bright green leaves of the new shoots rarely (from leaf-suppression) in flexuous panicles up to 4″ long, tomentose. Fr. globose 1–1·5″ diam. deep-green when ripe, sometimes tomentose, 2-4- usually 3-celled with very hard stone.

Not common in the Northern area. Central and Southern areas very common, especially in inferior forest on the hills with a clay soil. Chota Nagpur! S.P.! Gaya! Puri! Angul! Sambalpur! Orissa States, common, *Cooper.* Fls. April-June. The fruit ripens in January or up to a year after flowering. Deciduous and renews its leaves April-May.

Bark grey or brown with thick oblong scales when old, blaze thin crimson streaked with white. Shoots tomentose and often unarmed. L. glabrescent above or somewhat permanently pubescent on the nerves, rounded or obtuse, serrulate, rounded or subcordate at the somewhat oblique 3-nerved base. Fls. sometimes 4-merous. Pet. spathulate hooded. Disc flat persistent. Style shortly 2-4-fid, very minute at first, ovary quickly rising up above the disc on fertilisation and style elongating. Roxburgh says that the valves of the nut separate when this has been exposed for some time to the weather.

The fruit and bark have for a long time been employed for tanning by the Indian tanners and it has recently come again into prominence at the Esociet Tannin Research Factory. Mr. Fraymouth stated (1917) that taken at the right

time the fruit may yield as much as 20 per cent. and believed that it constituted the cheapest tannin in India. The kernel of the fruit is eaten. The wood is said to be hard and durable, reddish brown, but Gamble says not quite as good as that of *Z. jujuba.* It is one of the woods used by the Kols to obtain fire by friction.

4. **Z. œnoplia,** *Mill.* Dathora, *Kharw.*; Makai, *H.*; Siakul, *Beng.*; Burukoli, Kontaikoli, *Or.*

A straggling thorny shrub becoming a large climber festooning the highest trees, the trunk armed with large conical spine-tipped woody bosses. L. obliquely ovate, ovate-lanceolate or oblong-ovate 1–2·5″ with copious brown silky appressed hairs beneath. Cymes axillary under ·5″ long brown tomentose. Fr. small black succulent ·25″ diam. Stone rugose compressed, 1- rarely 2-seeded.

Throughout the province; commonest on sandy soils; Bettiah! Purneah! Singbhum, not common! Frequent in Gangpur, also in Manbhum, Hazaribagh, Ranchi, Palamau, S.P.! Common throughout the Southern area! Fls. June–Sept. Fr. Nov.–Dec. Evergreen, new leaves Feb.–April.

Twigs brown-tomentose. Prickles usually solitary small and hooked or with one nearly straight. L. acute or sub-acuminate entire or faintly crenate with very oblique 3–5-nerved base and very slender oblique silky sec. n. Petioles slender, ·12–·3″. Petals cucullate. Ovary 2-celled.

The branches are used for fencing. The fruit is eaten. A morbid condition is common bearing dense fascicles of small branches and tiny leaves, believed by Mr. Hole to be analogous to the condition of "spike" in Sandal.

5. **Z. funiculosa,** *Ham.*

A scrambler or climber with glabrous oblong to elliptic-lanceolate sometimes ovate conspicuously acuminate leaves 2·5–3·5″ long, with 3 prominent and usually 2 finer basal nerves, intermediate venation very fine and close giving the leaf a characteristic transversely striate appearance. Cymes peduncled, ·7–2″ long, dichotomous brown pubescent, sometimes panicled. Fruit obovoid densely tomentose when young or globose, older glabrous, ·5″ diam. Fls. Jan.–April. Fr. May.

Puri? (I have a single specimen marked Puri, 1915, but as I collected the same species in Burmah in 1914 the label may be an error and I have no field notes in connection with the Puri plant.)

6. **Z. rugosa,** *Lamk.* Sirka, Tsirka, *K.*; Sekra, *S.*; Pituar, Karail, *Kharw.*; Hohnoi, *Mal P.*; Kontai koli, Tinkoli, *Or.*

A large shrub or small tree with long pendent or, in favourable localities, widely scandent branches, large elliptic 3–5-nerved serrulate usually cordate-based leaves attaining 6″ by 4·5″ or more, and large tomentose panicles of greenish-yellow flowers arranged in peduncled cymes or the lower cymes axillary. Fr. ·3–·5″ diam. white fleshy with a thin-walled 1-celled and 1-seeded stone.

Throughout the whole area from Bettiah! and Purneah! to Sambalpur! Angul! and Puri! Ascends to the tops of the mountains but usually occurs near ravines, nowhere very abundant. Fls. Feb.–March. Fr. May-July. Sometimes nearly deciduous, renewing its leaves in May, or evergreen with new shoots in Jan.–Feb.

Young parts all tomentose. L. sometimes glabrescent or permanently brown pubescent beneath, apex rounded. One stipule usually a short prickle the other triangular and caducous. Fls. ·2–·25″, petals 0.

The fruit is eaten and is palatable. "The powdered bark mixed with ghee is applied to the swollen cheek in toothache and for ulcers in the mouth," *Camp.*

3. RHAMNUS, *L.* Buckthorn.

Shrubs or small trees. L. penninerved but often with 2 secondary nerves from near the base. Fls. fascicled in the axils of leaves or bud scales, or racemose, monœcious or diœcious. Calyx-tube

(hypanthium) urceolate or turbinate, lobes 4–5, keeled within. Petals 4–5 minute or 0. Disc lining the tube with thin margin, not swollen. Ovary free 3–4-celled. Fruit 2–4-celled, with 2–4 pyrenes, girt at base by the calyx tube, sometimes lobed.

Erect rigid. L. mostly under 3″ long lanceolate . . . . . . 1. *dahuricus*.
Sarmentose or erect. L. mostly 4–6″ oblong . . . . . . 2. *nepalensis*.

1. **R. dahuricus,** *Pall.*

A small bushy rigid tree or large shrub with smooth bark like that of a cherry, branches clothed with abbreviated closely scarred branchlets and sometimes ending in a sharp thorn, leaves small, often fascicled, ·7–3″ long, young pubescent. Fls. minute solitary or fascicled in the axils of bud scales on filiform pedicels ·2″ long.

Rocky places on the Neterhat plateau. Fls. March–April. Fr. May–June.
Distrib.: Himalayas and Ghats of Western Peninsula.
Branchlets often 4-farious. L. usually 1–2″ lanceolate, acuminate, finely serrate, pubescent on the nerves beneath; sec. n. 3–6, tertiaries very reticulate impressed. Peti. slender, ·1–·3″. Stipules filiform, pubescent. Fls. 1-sexual (sometimes polygamous?). Calyx tube ·05″, lobes 4, ·07″, caudate, 3-nerved. Pet. spathulate about half as long. Fil. shorter than petals. Fruit obovoid, somewhat compressed and faintly 2-lobed, ·15″ long seated on the hemispherical or patelliform calyx-tube. Pedicels and tube minutely pubescent.

2. **R. nipalensis,** *Lawson.*

A large suberect or rambling shrub with long brown sarmentose branches, sub-bifarious oblong acuminate serrulate shining leaves 3–6″ rarely 8″ long often interspersed with much smaller ones, petioles slender. Fls. small green pubescent fascicled in simple or compound racemes often with large foliaceous bracts. Capsule ·25–·3″ at first rather succulent, broadly obovate, 3-lobed when dry.

High mountains of Orissa, Meghasani 3500 ft! Fl. June–July. Fr. July–Nov.
Distrib.: Himalayas to Duars and Assam.
Branches dotted with prominent brown lenticels, young parts pubescent. L. glabrous with tufts of hair in the axils of several of the sec. n. beneath, base rounded obtuse or subacute, often rather unequal. Sec. n. about 6 of which 1 or 2 close to base, conspicuous but slender slightly curved, very oblique tertiaries very fine. Petiole ·3–·7″, pubescent or glabrous. Stipules subulate, caducous above and leaving a rounded base. Racemes pubescent. Fls. shortly pedicelled. Calyx lobes 5 lanceolate acute. Pet. 5 oblong concave over the stamens, caducous. Seeds brown shining oblong 2-sided within (*fide Wallich*).

4. SCUTIA, *Commers.*

Shrubs, usually armed with sharp hooked axillary, not stipulary, thorns and opposite or sub-opp. coriaceous penninerved leaves. It is usually said to differ from *Rhamnus* by the disc filling, not only lining, the calyx-tube but the character does not hold good as the disc is often quite as thin as, and closely resembles, some species of *Rhamnus*. Ovary nearly free, 2 (–3)-celled, base slightly sunk in the receptacle and the solitary ovule in each cell erect from the base. Fruit dry or very fleshy with 2–4 crustaceous pyrenes. Seed compressed with thin or no albumen and plano-convex fleshy cotyledons.

1. **S. myrtina,** *Kurz.* Syn. S. indica, *Brogn.*

A considerable shrub formidably armed with very sharp recurved axillary thorns, small shining opposite, sub-opp. or alternate one-

nerved leaves mostly about 1″ long, small white flowers ·15-·2″ diam. fascicled on very short peduncles and green berries ·3-·4″ diam. which *ultimately become dark blue.*

Scrub jungle near the Chilka Lake ! Fls., Fr. April-May (probably also at other times).

Twigs glabrous, or grey with quite microscopical hairs, younger marked with longitudinal stipular raised lines. Thorns often ·5″ long, but those on flowering branches may be undeveloped. L. ·8-2″ long, elliptic or ell.-obovate obtuse or rounded both ends, mucronulate. Mid-rib strong, sec. n. 3-6, very fine green, impressed beneath (not when dry), soon reticulate. Petiole ·1-·3″ slender. Stipules flattened subulate ·1″. Fls. 1-6 axillary, appearing fascicled, but umbellately cymose on very short peduncles ·02-·1″ long, which slightly elongate (up to ·1-·25″) in fruit. Pedicels ·05″ bracteate and 2-bracteolate at base. Bracts brown nearly as long as pedicels, ovate mucronate, bracteoles smaller. Calyx ·18″ (4 mm.) long including tube, lobes as long as tube, 5 lanceolate keeled within below the solid triangular tip. Pet. minute, broader than long, deeply emarginate and minutely apiculate in the sinus, sides incurved round the short flattened triangular filaments and base of anther which exceeds the petal. Disc thin lining the tube. Ovary base slightly sunk in receptacle and constricted above it, globose above constriction with stout conical style and 2 (-3) apical stigmatic surfaces. Ovarian cells in base of ovary mostly below the globose portion. Fruit 1-3-celled and -seeded, seated on the patelliform calyx-tube.

5. GOUANIA, *L.*

Unarmed climbing shrubs with the ends of the branchlets often modified into tendrils. L. alternate, stipulate. Fls. small polygamous, fascicled on the rhachis of spikes or racemes which are sometimes panicled. Fls. 5-merous (exc. the ovary). Disc more or less filling the calyx-tube with 5 processes alternating with the stamens. Ovary sunk in the disc, 3-celled, style 3-cleft. Fr. inferior 3-winged or sharply angled, coriaceous, splitting into three cocci through the wings and leaving a slender axis. Seeds with hard shining testa and fleshy albumen.

1. **G. leptostachya,** *DC.* Bitkil-chand, *S.*; Ramduri (teste *Gamble*); Rakta Pitchali, *Or.*

A tendril climber with green branchlets, broadly ovate cordate coarsely crenate leaves and green flowers fascicled on the rhachis of simple or panicled terminal racemes, and 3-winged capsular fruits.

Chiefly along nalas and ravines in Central and Southern areas. Purneah! Chota Nagpur, not very common ! S. P. ! Mayurbhanj ! Angul, frequent ! Puri! Fls. Aug.-Sept. Fr. Nov.-Dec. Usually deciduous in the dryer localities and renews leaves March-April, practically evergreen in Angul. The old dry open fruits may sometimes be found up to March.

L. 2·5-5″ by 1·5-4·5″ shining above, nearly glabrous except on the 6-7 strong sec. n. of which the lowest are basal, crenatures glandular. Petiole 1-2·5″. Racemes 6-8″, pubescent. Frt. ·3-·5″, broader than long, top emarginate crowned by the calyx. Seed black, compressed, broadly ovate-oblong ·17″.

The bark is used (ground up) for bruises in Mayurbhanj.

6. HELINUS, *E. Meyer.*

Unarmed climbing shrubs with some of the branchlets modified into tendrils. L. alternate entire with small deciduous stipules. Fls. small in peduncled cymose umbels, 5-merous (exc. ovary). Disc filling the calyx-tube, epigynous and ovary inferior, 3-celled with short 3-cleft style and small recurved stigmas. Fr. drupaceous with

a thin mesocarp, the putamen finally separating into 3 crustaceous pyrenes or cocci leaving the remains of the three septa, cocci ultimately dehiscent. Seeds with fleshy albumen and large flat cotyledons.

1. **H. lanceolatus**, *Brand.*

A bright green slender climbing shrub with ovate or lanceolate acute leaves about 2·5 by 1·25″ and very numerous small yellowish flowers in slender peduncled cymes which are axillary or paniculate by reduction of the leaves. Fr. ·25–·5″ diam.

Grassy valleys and sides of rocky ravines. Singbhum, not common! Ranchi, Neterhat! Santal P.! Fls. Jan.-April. Fr. April-May.

Branches finely ridged, puberulous. L. glaucous beneath, those on the inflorescence much reduced, 3-nerved with 1-2 sec. n. and reticulate nervules. Stipules ·05″. Fls. ·12-·2″ diam., shallow. Petals oblong whitish folded round the stamens which are inserted on the free margin of the disc with exserted anthers. Fruiting peduncle broadened above.

FAM. 47. AMPELIDACEÆ.

Erect or climbing herbs or soft-wooded shrubs, rarely small trees. Branchlets often transformed into tendrils in the Vines (*Vitis*). L. alternate, simple or compound, stipulate with petiole often sheathing at the base. Fls. small in compound inflorescences, regular, often polygamous, sometimes diœcious. Calyx small 4–5-lobed or truncate. Petals 4–5, hypogynous or perigynous, valvate, sometimes falling off as a cap without expanding (calyptrate). Stamens isomerous and opposite to the petals, sometimes perigynous, on or outside the disc, anthers 2-celled, introrse. Disc large or small, sometimes tubular and lobed. Ovary free or the base sunk in or surrounded by the disc, 2–6-celled, with 1–2 ascending anatropous ovules in each cell with the raphe towards the axis. Stigma simple or lobed. Fruit a berry. Seeds with copious hard albumen. Embryo short basal, cotyledons ovate.

NOTE.—Both the tendrils and the inflorescence in *Vitis* are morphologically main axes which get thrust aside with the growth of the stronger axillary shoots and thus often appear leaf-opposed.

Climbers. Stamens free on a hypogynous disc. Ovary 2-celled . . . 1. *Vitis.*
Erect. Petals and stamens perigynous and outside a lobed tubular disc
Ovary 3-6-celled . . . . 2. *Leea.*

1. VITIS, *L.* Vine.

Herbs or shrubs climbing by means of a modification of the stem or branches into tendrils, which sometimes bear the inflorescence. L. simple and palmately nerved or digitate or pedate. Fls. 4–5-merous. Petals often calyptrate. Disc of glands or lobed or annular. Stamens free. Ovary 2-celled, very rarely 4-celled, surrounded at the base or half way up by the disc. Ovules 2 in each cell. Berry 1–4-seeded.*

I. L. simple, often angled or lobed.
A. Fls. 4-merous (or ovary 2-merous). Fls. 2-sexual. Inflorescence not bearing tendrils (Cissus)*
1. Branches jointed, very thick and fleshy, angled . . 1. *quadrangularis*

2. Branches normal.
  a. L. glabrous. Somewhat fleshy herbs.
    Stem very glaucous, glabrous . . . . . . 2. *repens.*
    Not glaucous, stems more or less hairy . . . . 3. *assamica.*
  b. L. pubescent or tomentose.
    L. 2–4″, as broad as long, with short pubescence . . 4. *vitiginea.*
    L. 2–6″, ovate, tomentose. Cymes leaf-opposed . . 5. *adnata.*
    L. 5–8″, broadly ovate or orbicular, young tomentosely hairy. Cymes often panicled on leafless branches in flower . . . . 6. *repanda.*
B. Fls. mostly 5-merous, polygamous. Infl. tendrillate.
  1. Petals calyptrate (Vitis *proper*).*
    L. scarcely lobed, woolly beneath when young . . 7. *lanata.*
  2. Petals expanding (Ampelocissus).*
    Leaves angled or lobed, glabrous . . . . . 8. *latifolia.*
    Leaves deeply lobed, tomentose . . . . . 9. *tomentosa.*
II. L. 3-foliolate. Inflorescence tendril-bearing.
    Fls. 5-merous. Petals expanding (Ampelocissus) . . 10. *divaricata.*
III. L. 3- or 5–7-foliolate. Inflorescence not bearing tendrils. Fls. 4-merous.
  A. Fls. polygamous or diœcious. Petals or their tips spreading. Stigma large 4-lobed. Seeds furrowed, without deep pits (Tetrastigma).
    1. L. all 3-foliolate. Stigmatic lobes not papillose.
      a. Fls. very small, pet. with a dorsal apical spur. Disc large but thin, ovary glabrous . . . . 11. *bracteolata.*
      b. Petals not spurred, sometimes mucronulate.
        Cymes very short. Disc rather thick. Ovary pubescent 12. *angustifolia.*
        Cymes divaricate. Disc 0. Ovary glabrous . . . 13. *alcicorne.*
    2. L. mostly pedately 5-foliolate. Stigma papillose . . 14. *lanceolaria.*
  B. Fls. 2-sexual. Pet. connivent or spreading. Stigma minute. Seed with 1–2 pits covered by a membrane (Cayratia).
    1. L. all 3-foliolate.
      Herbaceous, rather fleshy. Lflts. hairy . . . . 15. *trifolia.*
    2. L. mostly digitately 5-foliolate . . . . . . 16. *auriculata.*
    3. L. mostly pedately 5–7-foliolate, hairy . . . . 17. *pedata.*

* NOTE.—Planchon in his monograph divided *Vitis* up into a number of genera and this arrangement has been adopted at Kew and in the *Madras Flora*. These genera are shown in brackets above, but the genus shown in one Key for the convenience of Foresters in the field.

1. **V. quadrangularis,** *Wall.* Syn. Cissus quadrangularis, *L.*; Harjora, *Beng.*; Harbhanga, *Or.*

A fleshy cactus-like jointed climber with 4-winged internodes and a tendril at some of the nodes, bearing in the rains and cold season short-petioled cordate leaves 1–2·5″ long and broad. Fls. greenish-white in short peduncled small glabrous umbellate cymes. Berries ·25″ diam., red, 1-seeded.

Not very common. Puri, both in the north and common on rocks near the Chilka Lake! Angul, near villages! Fls. r.s. Fr. c.s. Deciduous.

Stems often 1″ diam. sometimes festooning trees. L. very broadly ovate or reniform, rarely lobed, crenate-serrate, glabrous, leaf-opposed. Stipules foliaceous, ovate. Tendrils simple. Cymes with 3–4 umbellules. Seed fissured (*Roxb.*). The young shoots are eaten.

2. **V. repens,** *W. & A.* Syn. V. glauca, *Wallich's* No. 5990A; Cissus repens, *Lamk.*

A weak glabrous succulent trailer with very glaucous-white (less so when old) stems and sagittate or ovate cordate and acuminate

quite glabrous leaves 2–5″ long with rather distant small teeth, stipules large membranous amplexicaul broadly-ovate or -oblong, crumpled or broken off when old. Cymes leaf-opposed irregularly umbellate, 1–2″ long, glabrous or minutely hairy. Fls. small 2-sexual. Calyx prominent campanulate or saucer-shaped, subentire, much as in *V. assamica*. Petals 4 white, suberect, lanceolate, ·08–·1″, tip hooded, acute. Berries black, juicy, ·2–·25″ diam. Seed 1, ·2″ long, globose-pyriform, somewhat facetted or with raised reticulations, not scaly.

Mals of Orissa, rather rare! Fls. July–Sept. Fr. Nov.–Dec. New shoots appear in April and May. Distrib.: E. Bengal, Sikkim, Chittagong to Burma, also Madras.

Stems somewhat compressed waxy 5-nerved at base. L. gradually acuminate (in our area), sec. n. above basal 2–4 only. Petiole 1–2″, rarely up to 4″. Peduncles variable, usually short. Pedicels ·5″, swollen at apex. Ovary 2-celled. Stigma simple.

3. **V. assamica,** *Laws.* (*Wall.*, No. 6001, *Cal. Herb.* Syn. Cissus adnata, *Roxb. teste Planchon*, but this seems to me an error).

A sub-succulent climber, stems somewhat hairy at the nodes with appressed brown hairs and sometimes on the internodes, leaves ovate cordate, shortly caudate bristle-serrate when young, rather membranous, stipules oblong rounded, ·2″, spreading, leaving a persistent base on falling. Cymes umbellate leaf-opposed, 1–2″ long, hairy when young, sometimes panicled in fruit by fall of leaves. Fls. small, 2-sexual. Calyx prominent campanulate, ·07–·08″ diam., entire or crenulate. Petals 4 suberect, oblong, ·075″ long, tip hooded. Berry black, ·2–·25″ diam. Seed 1, pyriform with close grey flabellate scales,* otherwise smooth, raphe conspicuous.

Fairly common in the Mals of Orissa! Fls. July–Sept. Fr. Dec.

Stems somewhat obtusely angled. L. 4–6″, but attaining 7″ by 5″, shining both sides with a narrowly recurved margin, distinctly serrate when old, glabrous or often with a few long yellow hairs on the nerves, base 3–5-nerved, sec. n. above basal 4–6, strong gently curved excurrent. Petiole 2–4″. Tendrils simple or some forked at the extremity. Cymes with long rufous hairs when young, peduncles ·7–1″ (or in some Sikkim plants up to 2·7″), divaricate or ascending, fruiting pedicels ·2–·25″, sometimes verrucose. Ovary 2-celled, stigma simple.

The berries are not dry as stated in *F.B.I.* but are succulent and edible.

4. **V. vitiginea,** *nov. comb.* (*non* V. vitiginea, *Kuntze* = V. repanda). Syn. V. Linnæi, *Wall.*; Cissus vitiginea, *L.*; Jangli angur, H.

A weak hoary pubescent climber with corky bark, membranous simple cordate lobed and coarsely dentate leaves mostly about 3″ diam., and umbellate compound cymes of small white 4-merous flowers. Fruit pale purple pruniose, 1-seeded on deflexed pedicels.

Puri, near the coast (Konarak)! Fls. July–Sept. with the fully developed leaves. Fr. Oct.–Nov. Dies down at end of cold season.

Stem and leaves beneath and inflorescence clothed with a short curly pubescence. L. also puberulous above, 2–4″, basal sinus wide, 3-nerved, sec. n. ending in the obtuse teeth. Petiole ·7–1·5″. Stipules under ·1″, rounded, deciduous. Tendrils simple. Cymes 1–1·5″ diam. with about 3 rays only, pedicels 3-many.

* Not seen in Herbarium specimens as they get removed with the adhering flesh.

5. **V. adnata,** *Wall.* *Wall.*, No. 5998 (not 6001). Syn. Cissus adnata, *Roxb.*

A climber sometimes attaining large size, leaves ovate acuminate with cordate base, bristle-serrate when young, usually 2–6″ long and never as broad as long, floccose hairy or tomentose beneath. Cymes umbellate, leaf-opposed and about as long as the leaves opposed to them. Fls. ·12″ diam., 4-merous with broadly oblong-ovate greenish spreading petals. Berries purple-brown, globose-pyriform, ·3″ long. Seed somewhat obliquely pyriform, sharp pointed at base, ·2″ long, brown, smooth (facetted in *herbaria*, but this is not evident in the ripe fresh seed).

Purneah, common in the north! Fls., Fr. Sept.–Jan.

Not nearly so large a climber as *V. repanda*. Stems much harder, less succulent, and not corky, often flattened on two sides and grooved on the flat sides as in some other species. Leaves much smaller, but rarely they attain 8″ length. Cymes arising in succession on the firm striate leafy branches, not in leafless panicles, compact, umbelliform, 1·5–2″, rarely 3″ long, including the peduncle. Pedicels much recurved in fruit.

The red tomentum is sometimes given as a distinguishing character, but the red is often entirely absent,* while the tomentum of *V. repanda* is sometimes red. I have never seen the shoots clothed with imbricating stipules as occurs in rapidly growing specimens of *V. repanda*.

6. **V. repanda,** *W. & A.* Syn. Cissus repanda, *Vahl.*; Bambor, *K.*; Bod-lar-nari, *S.*; Gonvehli, *Gond.*; Harjarwa, *Kharw.*; Panlati, *Th.*; Takwale, *Or.*

A large climber with soft very porous wood and corky bark, large simple deeply cordate usually repandly toothed leaves 5–8″ diam., and long-peduncled tomentose irregularly-branched cymes, finally umbellate, which often appear copiously panicled before the advent of the leaves. Fruit ·35–·4″, pyriform. Seed pyriform, nearly smooth, ·3″ long.

Throughout the whole area (in favourable localities) from Champaran to Southern Puri, Angul and Sambalpur! Chiefly in valleys and the damper jungles and is therefore rare in the Central and Northern tract. Ascends to 3000 ft. at Neterhat and Parasnath (4000 ft.)! Fls. April–June on the new shoots before and after expansion of the new leaves. Fr. June–July. Deciduous Feb.–May, the leaves turning yellow in December.

New shoots tomentose and hairy, tomentum often ferruginous. L. sub-orbicular to broadly ovate with deep basal sinus 5–7-nerved, the strong sec. n. running out into small teeth, under surface villosely tomentose when young and less so above, finally glabrous both sides. Petioles 6–12″ long. Stipules oblong, ·2–·3″, rounded, imbricate on young flowerless shoots on the terminal bud, sometimes falcate. Tendrils forked or dichotomous. Cymes terminating the new shoots, and from the old nodes, each becoming in turn leaf-opposed, 3–5-rayed and rays again rayed or with umbelled pedicels ·1–·3″ long. Peduncles 2–5″. Fl. buds often red ovoid and sub-umbonate pilose. Calyx ·07″ diam., truncate. Petals ovate calyptrate or expanding widely and reflexed, boat-shaped at the apex. Disc 4-lobed. St. from between the lobes. Young fruits ellipsoid apiculate on somewhat recurved elongated pedicels.

The stems yield a quantity of drinkable water. "The root, powdered and heated, is applied to cuts and fractures. The bark and stalk yield a good cordage fibre." *Campbell.*

To obtain the water cut obliquely through the soft stem with one clean blow, then cut through it again higher up when the water in the piece will at once run out from the lower end.

* This red appearance is also to a great extent a herbarium character. I find that my specimens collected without a trace of red gradually change to red after drying.

7. **V. lanata,** *Roxb.* Kolo nari, S.

A climber which in form of leaf sometimes resembles *V. adnata*, but it may be at once distinguished by the polygamous diœcious flowers being arranged in thyrsoid panicles 3–6″ long, opposite to the leaves and usually tendril-bearing, by the 5-merous slender pedicelled flowers with calyptrate corolla and the very slender filaments of the male.

Manbhum, *teste Campbell & Watt*; but I have seen no specimens from our area and it may be an error in identification. It is a plant of the lower Himalayas, Eastern Bengal and the Eastern Ghats. Fls. Feb.–May.

The leaves are ovate cordate, sometimes slightly 3-lobed, 2·5–8″ long, densely lanate when young, but in one variety glabrescent. Seeds pyriform, somewhat 2-furrowed on the inner face and 1-furrowed on the outer.

8. **V. latifolia,** *Roxb.* Syn. Ampelocissus latifolia, *Planch.*; Oteron, *K.*; Icewer, *S.*; Khopri, *Kharw.*; Govela, *Beng.*; Pani-kacho, *Or.*; Paniloha (Bonai, *f. Cooper*).

An extensive but scarcely woody climber, glabrous or nearly so, except the rhachis of the inflorescence, with simple palmately rarely deeply-lobed leaves 4–8″ long and broad, deep brown-red flowers and black succulent berries ·3″ diam., which are sweet and juicy.

Throughout the area. Very common, especially in low scrub jungles in Chota Nagpur, Rajmahal Hills and Orissa! Fls. June–July. Fr. Aug.–Oct. The stems die down annually to the perennial rootstock, which sends out long bare shoots in May and June sometimes to a height of 10 ft. before the leaves expand, and it flowers before the leaves are fully developed.

New stems glaucous or quite blue, hollow, and often producing the inflorescence before the leaves. L. 3–7-angled or -lobed, lower sometimes 3-lobed half-way down while the upper are shallowly 3–7-angled, mealy when very young, cordate or retuse at the base, crenate-serrulate or dentate. Fls. rarely 4-merous, in pyramidal panicled cymes borne on a very stout peduncle together with a forked tendril. Petals ·06″, oblong, red, expanding, saccate at the apex. Disc prominent lobed becoming adnate and often showing as a ring on the fruit. Seeds 2–4, ·22″ long, roughly plano-convex with convex side rugose, sides rugose and a strong ridge on the plane face.

The fruit is eaten.

9. **V. tomentosa,** *Heyne.* Syn. Ampelocissus tomentosa, *Planch*: Oteron, *K.*; Ghora-lidi, *S.*

An extensive but scarcely woody climber, densely often ferruginous tomentose with large orbicular very deeply cordate leaves often attaining 10″ both ways and 3–5-lobed. Fls. sessile, red, in divaricate cymes on a peduncle under 1″ long which again is borne together with a tendril on a common woody branchlet 3–6″ long. Berry black, ·3″ diam.

Central and Southern areas, common. Gaya! Hazaribagh! Ranchi! Palamau, ascending to the top of Neterhat! Santal Parg.! Angul! etc. Fls. July–Sept. Fr. Sept.–Nov. Often dies back in the hot season.

Shoots covered with a dense cottony tomentum. L. with a dense brown tomentum beneath, basal lobes rounded, margin serrate or serrulate. Petiole 3–6″. Petals spreading, usually 5. Seeds obcordate, furrowed and keeled on the inner face, pitted on the outer with rayed fissures from the pit.

10. **V. divaricata,** *Wall.* Syn. Ampelocissus divaricata, *Planch.*

A somewhat extensive climber with cottony tomentose but glabrescent branches, 3-foliolate membranous leaves with rather large

ovate-oblong or oblong-lanceolate acuminate terminal leaflets and ovate-lanceolate semi-cordate lateral leaflets, crenate-dentate with the teeth sub-spinulose. Fls. reddish in rather dense 2-3-chotomous cymes 1·5–2″ diam., borne laterally on the tendril-branches.

Sameshwar Hills, common! Fls. Oct.–Nov. Fr. Dec. (ripe ?).

L. cottony-tomentose beneath or old ones only pubescent on the nerves. Petiole 2–4″. Terminal lflt. 4–8·5″ and up to 3·3″ broad, lateral nearly as long and often broader, sometimes with a large side lobe near the middle, sec. n. 6–7, of which one or two from the base, or primary nerves 3–5. Tendrils once or twice forked with a bract at each fork. Cyme branches divaricate with linear bracts at the forks, peduncle ·75–1·5″ long, stouter than the common peduncle of cyme and tendril which is 3–5·5′ long. Calyx spreading, thin, scarcely lobed. Disc large, cupular, about 10-pleated and -lobed. Stigma sessile. Ovary 2-celled. Fruit (not seen by me) said to be black and 3–4-seeded with seeds ·3″, almost round, flat and emarginate.

11. **V. bracteolata,** *Wall.* Syn. Tetrastigma bracteolatum, *Planch.*

A medium-sized vine nearly glabrous except the inflorescence with 3-foliolate leaves, thin leaflets 3·5–5·5″ long, ell. or ovate acuminate serrate or crenate-serrate acuminate, sometimes puberulous or pubescent on the nerves beneath. Fls. very small, diœcious, greenish, 4-merous in axillary puberulous or pubescent 3-chotomous cymes, shorter or longer than the petiole (2–4″ long and broad), petals oblong ovate, ·04–·05″, with the inflexed acute tip furnished with a small dorsal spur or tail. Disc large but thin, girting the ovary half-way up in the female. Fruit black, succulent, ·3–·4″ diam., usually marked equatorially by a white line (the remains of the disc margin).

Purneah! Fls. Sept.–Dec. Fr. Dec.–Feb. Common in the Bengal jungles east of Purneah.

Stems flattened sub-woody ·3–·4″ diam. Lateral leaflets with base oblique and usually rounded, sec. n. 7–10, curving within the margin and each giving off a branch to a tooth. Petiole 2–3·5″ and petiolules ·3–·5″, puberulous. Cyme bracts oblong deciduous, leaving prominent scars, peduncle ·7–2″. Calyx saucer-shaped distinctly 4-toothed. Spur on petals making the buds 4-corniculate. Stigma sessile on the glabrous ovary with 4 acute lobes. Seeds 1–2 rounded or plano-convex, somewhat depressed on the plane inner side and with prominent linear raphe, 1–2-furrowed (with sometimes 1–2 shorter furrows) on the convex side and faintly transversely rugose on the rounded edges.

12. **Vitis angustifolia,** *Laws.* Syn. Cissus angustifolia, *Roxb.* (?); Tetrastigma Thomsonianum, *Planch.*

A rather slender climber, pubescent or puberulous all over except the leaves, which are 3-foliolate somewhat resembling those of *V. bracteolata*, but narrower lanceolate and lateral with lower half of leaf much more equal and base usually cuneate, larger leaflets 5·5 by 2″, thicker or more succulent than those of *V. bracteolata* (membranous in the herbarium) and with sec. n. only 5–7. Cymes dense and densely pubescent not exceeding 1·5″. Fls. small greenish-yellow, diœcious. Ovary papillose-pubescent. Stigma peltate, scarcely lobed. Berries spherical, pink, white or yellow, or ripe bright red, fœtid when bruised.

N. Purneah in river-side jungles. Fls. Feb.–March. Fr. Oct.–Jan.

Stems flattened. Base of petiole, petiolules and inflorescence often pink. L. acuminate puberulous on the mid-rib and also on the nerves beneath or glabrous.

Petiole 1·5″ thickened below. Petiolules nearly equal or terminal longer ·5–·6″. Stipules large oblong or somewhat triangular, ·25″, breaking off above the permanent base. Cymes with orbicular or oblong bracts on the ·2–1″ long peduncle. Petals not or rarely corniculate at tip. Disc rather thick round base of ovary. Seeds furrowed on each face and transversely rugose on the sides.*

Planchon throws doubt on this being Roxburgh's *Cissus angustifolia* because the latter came from Sumatra, but the figure and description are wonderfully suitable, and until the Sumatran plant is shown to be different I am inclined to keep Roxburgh's name.

13. V. alcicorne, *Haines.* Syn. Tetrastigma alcicorne, *Haines in Kew Bulletin*, 2, 1920.

A climber, glabrous except the inflorescence, with 3-foliolate leaves, leaflets shining both sides, 3·5–4″ long, lateral elliptic terminal obovate, suddenly shortly caudate, remotely crenate in the upper half with sharp short teeth in the sinuses. Fls. small diœcious greenish-white, 4-merous in axillary puberulous dichotomous cymes, 1–2·5″ long, shorter or longer than the petiole, with oblong or lanceolate-oblong puberulous flexuous petals ·05″ long with the tip usually obtuse and mucronulate, not appendaged. Bracts on the cyme sub-persistent ovate ·05–·06″ long.

Sameshwar Hills, Champaran! Fls. Nov.–Dec.

Stems somewhat flattened. Tendrils leaf-opposed long simple. Lflts. with 4–6 sec. n. only. Petiole 2–2·5″. Rhachis with terminal petiolule ·8–1·25″ long. Cyme branches usually flattened and wider above upwards. Calyx small saucer-shaped. Disc very small annular. Petals convex below, concave in the middle and again with a spreading and inflexed tip. Fruit not seen.

14. V. lanceolaria, *Laws.* Syn. Cissus lanceolaria, *Roxb.*†; Tetrastigma lanceolaria, *Planch. Wight's Icones*, tab. 28.

A large climber nearly glabrous exc. the inflorescence and stipules, with pedately 5 (-3)-foliolate somewhat fleshy leaves, lanceolate elliptic or oblanceolate distantly crenate-serrate leaflets 3–6·5″ long. Cymes axillary or sub-axillary very shortly peduncled, dense, papillose, corymbose, rarely on the new shoots terminating long leaf-opposed peduncles which take the place of tendrils. Fls. yellowish, ·1″ long, polygamo-diœcious, the buds oblong truncate, each petal sometimes with a spreading cusp. Berry ·4″, seed ·3″ long, rounded oblong with a broad groove on back and rounded end and a V-shaped groove and ridge on the inner face.

Not common. Damper regions along foot of Nepal Hills from Champaran! to Santal Parganahs (near Sahebganj)! Parasnath, *Camp.*! Fls. Jan.–March. Fr. June–July.

Larger stems woody, flattened and grooved. Tendrils simple, leaf-opposed. Petioles 2–6″. Stipules oblong-lanceolate deciduous ·5″. Lflts. shortly sharply acuminate, with one fine and rather indistinct sec. n. to each tooth, tertiary nerves obscure, mid-rib broad. Petiolules stout, often shortly pubescent. Calyx inconspicuous. Petals ovate-oblong papillose-pubescent. Stamens long in the male, in female reduced to staminodes, disc at base of the grooved conic ovary, stigma shortly 4-lobed with papillose-fimbriate lobes.

15. V. trifolia, *L.* Syn. V. carnosa, *Wall.*; Cayratia carnosa, *Gagnep.* Amar-lati, *H.*

An herbaceous climber with succulent compressed stems springing

* The seed described for this plant in the *F.B.I.* evidently belongs to a species of Cayratia and it could not have belonged to this species.

† The female was not known to Roxburgh.

from a stout perennial rootstock, with 3-foliolate leaves and crenate or dentate leaflets usually 2–3″ long, pubescent both sides. Fls. small with green petals and conspicuous white cupular 4-lobed and crenate disc, in lax divaricate long-peduncled cymes 2–3·5″ diam. Berries black, depressed globose, ·5–·7″ diam., 2–4 seeded.

Throughout the whole area, sometimes adhering to rocks and trees by the expanded tips of the tendrils. Champaran! Purneah! S.P.! Gaya! Throughout Chota Nagpur, though nowhere very abundant, ascending to 3000 ft. at Ichadag and Neterhat! Puri, very common! Fls. April–Sept. Fr. Sept.–Dec. It often dies back in Jan. and Feb.

Stems thin or attaining 1″ diam. with a corky bark, branches brittle, young striate pubescent or villous. Lflts. sometimes attain 5″ by 3″, usually coarsely crenate with a fine point from the sinus but sometimes coarsely serrate or irregularly dentate, the latter form somewhat hispid on the nerves only, terminal elliptic or obovate, lateral usually broadly ovate and somewhat cordate at the base. Petiole fleshy, 2–4″. Tendrils slender branched. Cymes thinly hairy. Calyx cupular. Petals rarely white, ·08–·09″, saccate at the tip. Style prominent, subulate, often pink with simple stigma.

16. **V. auriculata,** *Laws.* Syn. Cissus auriculata, *Roxb.*; Cayratia auriculata, *Gamble*; Baiang, *K.*; Amar-lata, *Kharw.*; Kanjkanjia, *Or.*

A large sub-succulent climber with digitate rarely pedate 5(–3)-foliolate leaves, long petioluled crenate or crenate-serrate leaflets 3–5″ (or small lateral ones only 2″) shining above, pubescent beneath and large divaricating cymes on long succulent peduncles. Fruit cherry-like, ·7″ diam. and red or pink when ripe.

Widely distributed in the damper jungles, usually near water courses. Sameshwar Hills! Chota Nagpur, all districts, occasional near streams! Puri! Mayurbhanj! Angul, occasional! Fls. July–Sept. Fr. Oct.–Dec. Deciduous.

Stems up to 1·5″ diam., corky when old. New shoots and leaves densely pubescent with short white hairs, clothed with large scimitar-shaped or half-orbicular stipules ·7–1·5″ long. Digitate and pedate leaves may occur on the same plant, usually digitate. Petiole 3–7″. Lflts. only 3 in some leaves broadly elliptic to obovate, shortly acuminate, sec. n. about 7 and tertiaries prominent. Petiolules from ·5″ in lateral to 2″ in terminal leaflets. Tendrils 2–3-fid. Fls. greenish-white. Seed 1.

The fruit is said to be eaten. I have not found it edible.

17. **V. pedata,** *Vahl.* Syn. Cayratia pedata, *Juss.*

A large weak climber with young branches and pedately 7-foliolate leaves softly hairy, leaflets 4–8″, strongly veined between the sec. n. beneath. Fls. 4-merous, small, green or white in large sub-corymbose cymes as long as the petiole. Fruit sub-globose 2–4-seeded, rather dry.

In the more humid districts only. Bhagalpur and S.P. towards the Ganges! Narsingpur! Khandpara! Nilgiri! Balasore! Mayurbhanj! Puri, common! Fls. Aug.-Sept. Fr. Oct.-Jan.

Lflts. 4–8″ or lateral only 2″ oblong-lanceolate, lateral unequal-sided and often elliptic, sharply acuminate, base often cordate. Petiole 3–6″. Tendrils forked at the ends. Fruit ·2″ diam. depressed. Seeds convex and concave, the concave side closed by a membrane.

2. LEEA, *L.*

Stout herbs, shrubs or small trees, erect and without tendrils usually with herbaceous branches. Leaves large with sheathing

petiole, simple or usually pinnately decompound. Peduncles leaf-opposed. Fls. in corymbose cymes. Petals and stamens perigynous inserted on a hypanthium which is prolonged into a tubular lobed disc. Ovary-cells 3–8, 1-ovuled. Berry 3–6-seeded, or seeds fewer.

I. Petals and inflorescence red.
 L. 1-pinnate, lflts. sessile . . . . 1. *alata.*
 L. 2-pinnate, lflts. petioluled . . . . 2. *acuminata.*
II. Petals green or white. Inflorescence not red.
 A. Herbaceous, with lower leaves very few large simple cordate, rarely one or two upper pinnate . . . . 3. *macrophylla.*
 B. Suffruticose. L. 1-2- or few 3-pinnate. Sec. n. close parallel, one to each tooth or bifurcate with a branch to each tooth.
  1. One sec. n. to each tooth. Corymbs sub-sessile. Stems with usually crisped wings . . . . 4. *crispa.*
  2. Nerves less than one to each tooth. Corymbs peduncled.
   Lflts. usually setose and with cordate base . . . 5. *aspera.*
   Lflts. not or only slightly setose, base not cordate, usually rhomboid . . . . [*herbacea*].
 C. Shrubs or small trees, lflts. with usually 3 or more teeth to each sec. n.
  1. Lflts. without scales beneath.
   Lflts. glabrous . . . . 6. *sambucina.*
   Lflts. pubescent beneath, at least on nerves . . . 7. *robusta.*
  2. Lflts. with many small peltate scales beneath . . . 8. *æquata.*

1. **L. alata,** *Edgew.*

A shrub 2–5 ft. high, with simply pinnate leaves and oblong or oblong-oblanceolate serrate sessile or sub-sessile leaflets 6–12″ long. Fls. red as is also the whole inflorescence and fruit.

Not at all common in our area Manbhum, *Camp.*! Occasionally found in first-class Sal forests in Chota Nagpur, *Gamble* and *Manson*. It probably also occurs in Purneah. Fls. June–Aug. Fr. ripens Sept. It dies down anually.

L. 3-7-foliolate, petioles winged below, reddish. Lflts. with several serratures to each sec. n., tertiary nerves numerous, close and parallel. Peduncles usually long and slender.

2. **L. acuminata,** *Wall.*

A handsome shrub 4–8 ft. high, with 2-pinnate leaves often red, leaflets ovate to lanceolate acuminate, almost silvery beneath when young and shining above, crenate-serrate or serrate, 2·5–5″ long, with slender petiolules ·2–·35″. Fls. scarlet in puberulous scarlet corymbs 2-4″.

Mountains of Mayurbhanj. 2000–3000 ft.! Fls. May–Sept. Fr. Aug.–Sept.

L. many-foliolate, glabrous. Petioles with large connate auriculate stipules which are deciduous. Leaflets with 7–11 sec. n., each sec. n. supplying 2–4 teeth. Corymbs branched, sessile or peduncled. Lobes of staminal tube sub-quadrate emarginate. Berries ·25–·3″ with 4–6 carpels.

Both this and the preceding are common in the Eastern Sub-Himalayan region.

3. **L. macrophylla,** *Horn.* Hatkan, *S.*; Dholsamudra, *Beng.*; Garurain, *Th.*

A robust herb 1–3 ft. high, with annual shoots from a perennial stock, large ovate-cordate leaves 1–2 ft., very large stipules and white flowers in sessile corymbs. Fr. black, succulent, ·3″ diam.

Champaran, frequent! Purneah! Santal Parganas and Chota Nagpur, but not common! Fls. June. Leaves turn yellow in January and plant dies back in February.

I have sometimes observed one or two pinnate leaves at the top of the stem in robust specimens.
The root is applied externally to allay pain, *Camp.*

4. **L. crispa,** *L.* Ban-chalita, *Beng.*; Gorar, *Th.*

An erect sub-herbaceous plant with annual stems from a perennial stock. Stems, petioles and peduncles ridged or with very crisped wings. L. pinnate or some 2-pinnate, lflts. with very parallel sides or some ell.-oblong, coarsely serrate, with strong parallel sec. n. each carried into a serrature. Corymbs sub-sessile, stout. Berry blue-black.

Grass lands of N. Champaran, frequent! Purneah, very common! Palamau, grass lands, ascending to the tops of the pats! Singbhum (near Gamaria), rare! Mayurbhanj, about 2000 ft., common! The Singbhum form is not winged. Fls. June-Aug. Fr. Sept.-Oct. Leaves turn red before dying in December.
Ridges or wings about 8. Lflts. often with as many as 18 sec. n. only ·17″ apart, quite glabrous above, puberulous beneath; not caudate.

5. **L. aspera,** *Edgw.* Syn. L. herbacea, *Ham.*; Hom, *Ho.*; Horom, *M.*; Gorar, *Th.*

A shrub scarcely woody, spreading or in some situations with many erect or curved stems from the root attaining 12–20 ft. high and 2″ diam., soft-wooded with very large pith, never winged. L. 1–3-pinnate, but usually only 2-pinnate with mostly elliptic or ovate caudate leaflets with rounded or cordate base, strongly often coarsely serrate, with most of the strong sec. n. supplying more than one tooth, always pellucid punctate and more or less asperous or hirtellous above and puberulous or pubescent on the nerves beneath. Cymes small, rarely exceeding 4″ in breadth, with ascending more or less 2-winged compressed branches. Berries depressed glaucous or of a slatey-green colour and finally black, 5-seeded.

Very common throughout the Province and ascending to the tops of the hills in shady places. Fls. June–Sept. Fr. Nov.–Dec. The leaves turn red after fruiting and the stems break off at a node close to the ground.
Stems often longitudinally banded and with a minute microscopic tomentum. Base of lflts. 5-7-nerved. Cymes bifurcate at the base or with a peduncle up to 3″ long, bracts linear-setaceous caducous, sometimes white. Lobes of disc-tube narrow oblong or lanceolate, usually 2-toothed. Petals lanceolate.

NOTE.—*L. herbacea* is usually separated from *L. aspera* by the characters given in the key but I find these quite unworkable in the forest. The long-stemmed form may differ from the shorter one but I think this depends on locality.

6. **L. sambucina,** *Willd.* Giringa, *Khond.*

A large woody shrub or sub- or quite arboreous (*L. umbraculifera, Clarke*), with 2–3-pinnate glabrous leaves, large oblong or lanceolate acuminate or caudate coarsely doubly serrate somewhat chartaceous leaflets with sec. n. much curved or looped within the margin and 3–5 times as many teeth as sec. nerves. Corymbs large panicled, 2–3-chotomous, 4–10″ diam.

In the more humid forests. Santal Par., ravines in the Rajmahal Hills! Angul! Puri (common in the Mals)!
Fls. June–Sept. Fr. Oct.–March (usually Oct.–Dec.).
Stems up to 9″ girth. Lflts. attain 12″ by 3·5″, occasionally ovate at the base of the pinnæ and only 3-4″, base usually rounded, sec. n. 7-15 much

raised beneath united by fine parallel tertiaries. Petiolules ·2-1″. Panicl branches compressed. Fls. green with yellowish staminal-tube, or white. Berrie succulent turning from green to black pruinose, ·3-·35″, depressed 3-6 seeded.

7. **L. robusta,** *Roxb.* Hom, Horom, *K.*; Haramda, Hatkan, *S.*

A large sub-woody shrub 4–6 ft. high, with more or less tomentose branchlets, large 2–3-pinnate leaves with the leaflets either pubescent beneath, or pubescent or somewhat hispid on the nerves only beneath, oblong to oblong-lanceolate or ovate-lanceolate acuminate, attaining 12″ by 3·5″, with several serratures to one sec. nerve. Fls. green with white staminal tube in large branched usually geminate corymbs 7-15″ across. The plant somewhat reminds one of an Elder bush.

In ravines or along nalas or on cool aspects, fairly frequent in Chota Nagpur! Santal P.! Puri! Angul! Probably throughout the area in favourable positions. Fls. Aug. Fr. Nov.–Dec. Apparently dies down annually in some districts.

Leaves 2-3 ft. Lflts pale beneath with about 11-13 prs. sec. n. above the 5-7-nerved base which is sub-cordate, tertiary nerves numerous strong parallel. Cymes 2-3-chotomously branched, brachiate, pubescent. Berry purple black, ·3-·35″ diam. depressed. Bracts not persistent.

8. **L. aequata,** *L.*

A large shrub with smooth erect stems or sub-arboreous easily distinguished by the hirsute twigs, petioles and inflorescence and the numerous small peltate raised glands on the leaves beneath. Corymbs small, 2–4″ diam., sessile or shortly peduncled. Berries first red, finally black.

Mals of Orissa, frequent! Fls. r.s. Fr. Nov.–Jan. Old fruits remain till April. Perennial. New shoots May–June.

Sometimes almost arboreous. Leaves 2–1-pinnate, usually the lowest pinnæ of a leaf again pinnate with about 3–5 leaflets. Lflts. somewhat resembling those of *L. sambucina*, larger 7–9″ long, narrow-oblong or oblong-lanceolate, or lanceolate or terminal rhomboidly-lanceolate, caudate, base rounded, above with scattered hispid hairs, beneath hispid on the nerves, margin sharply serrate, usually 2–3 teeth to each strong sec. n., tertiaries strong parallel. Lateral petiolules ·2–·5″. Peduncle of cymes 0–1″, many of the hairs glandular on the branches. Berry ·3–·35″, depressed 3–6-seeded (lobed when dry as in other species).

FAM. 48. STAPHYLEACEÆ.

Trees or shrubs with alternate or (in our species) opposite imparipinnate stipulate leaves. Fls. regular 2-sexual panicled. Sepals 5, free or nearly so, hypogynous. Petals 5, imbricate. Disc annular lobed. Stamens 5, inserted outside the disc opposite the sepals, anthers 2-celled introrse. Ovary of three carpels, free or combined; styles 3 short, stigmas capitate; ovules 2 or more in each cell. Fruit baccate or of three dehiscent carpels. Seeds 1–many in each cell, albuminous, sometimes arilled, with flat or plano-convex cotyledons.

1. TURPINIA, *Vent.*

L. opposite imparipinnate with opposite serrate stipellate leaflets. Fls. small in terminal and axillary panicles with opposite branches. Ovary 3-lobed, 3-celled. Fruit a 3-celled fleshy berry. Seeds angled, exarillate, with hard shining testa, large hilum and fleshy albumen.

1. T. pomifera, *DC.* Syn. Dalrymplea pomifera, *Roxb.* (1824); Turpinia nepalensis, *W. & A.* (1834).*

A small tree with opposite pinnate 5–7-foliolate glabrous leaves, elliptic serrate finely acuminate minutely stipellate leaflets 3–6″ long, and small regular yellowish flowers in axillary panicles as long as the leaf rhachis. Frt. subglobose indehiscent 3-celled, 3-lobed.

My specimens were with withered flowers and in young fruit and I was therefore unable to satisfactorily determine either the colour of the flowers or the size of the ripe fruit.

Mayurbhanj, evergreen forest 3000 ft.! Fls. April–May. Fr. ripens (?). Evergreen. Bark rugose, grey, blaze white with a chlorophyll layer then dirty yellow darkening on exposure to brown. Terminal bud thinly pubescent. L. rhachis 4–6″. Stipules deciduous. Lflts. elliptic, lanceolate or ell.-oblong with cuneate base, terminal somewhat obovate. Petiolule ·15–·3″, of terminal leaflets 0 (the position of the stipellæ shows that the so-called terminal petiolule is part of the rhachis). Stipellæ minute subulate, persistent. Panicles minutely puberulous above, lax. Fls. ·25″ diam., sep. 5 rather unequal, ciliate, nerved. Pet. 5, oblong. St. 5, with flattened subulate glabrous filaments inserted outside the lobed disc. Ovary 3-lobed and 3-celled, each lobe with a distinct style widely separated in fruit but slightly cohering in flower. Ovules 5–6 in each cell, axile pendulous. Frt. (young) 3-lobed, each lobe grooved.

Gamble gives the weight of the wood as about 30 lb. It is apparently not used.

FAM. 49. SAPINDACEÆ.

Trees or shrubs or (*Cardiospermum*) climbing herbs with alternate pinnate or rarely 1–3-foliolate exstipulate leaves. Fls. small or mod.-sized, usually polygamous and more or less irregular, more rarely quite regular. Calyx 4–8-lobed or -sepalous, valvate or imbricate. Petals as many as or fewer than the sepals or 0, often bearded or squamate at the base. Stamens 4–10, usually 8, free, inserted inside, rarely outside an annular disc or disc unilateral, often lobed, sometimes 0 in male flowers. Ovary entire or lobed, sometimes excentric, usually 3-celled, cells 1-, rarely 2-ovuled. Fruit capsular or indehiscent and baccate, sometimes bladdery, entire lobed or winged. Seeds often arillate, albumen 0, embryo normally with curved or convolute cotyledons.

A. Climbing herbs with tendrils and ternately divided leaves. Disc unilateral . . . . 1. *Cardiospermum.*
B. Erect trees or shrubs. Stamens inside the disc or unilateral.
 1. Fls. zygomorphic, disc often unilateral or lobed.
  a. Shrubs with 1–3-foliolate leaves . . . . . . 2. *Allophylus.*
  b. Trees with 5-more-foliolate leaves.
   Leaves odd-pinnate. Carpels nearly distinct in fruit 3. *Erioglossum.*
   Leaves paripinnate. Fruit not deeply lobed . . 4. *Lepisanthes.*
 2. Fls. regular or stamens somewhat unilateral, disc annular or 0 (*Harpullia*).
  a. Petals 0. Ovule 1 in each cell. Frt. entire . . . 5. *Schleichera.*
  b. Petals small (or 0 in *Nephelium litchi*). Ovule 1 in each cell. Fruit lobed or 1-coccous (only one lobe developing).
   i. Trees. L. paripinnate. Cocci or lobes rounded.
    Calyx 4–8-lobed, sub-valvate. Coccus 1, crustaceous usually rough . . . . 6. *Nephelium.*
    Sepals 4–5 imbricate. Cocci globose fleshy . . 7. *Sapindus.*

---

* *Turpinia nepalensis* is a small-fruited tree and may differ from *T. pomifera, DC.*, which has large fruits.

ii. Trees or shrubs. L. paripinnate or 1-foliolate.
Sepals 4–5 imbricate. Cocci or drupels oblong . 8. *Aphania*.
c. Petals m.s. Ovules 2 in each cell. Frt. an inflated capsule . . . . 9. *Harpullia*.
C. Shrub. Stamens outside the disc, or disc absent. Petals 0. Leaves simple . . . . 10. *Dodonea*.

1. CARDIOSPERMUM, *L.*

Slender climbers with biternate leaves, coarsely dentate leaflets and small flowers in axillary racemes, the lowest pair of pedicels being developed as spiral tendrils. Fls. polygamo-diœcious. Sepals 4, two outer smaller. Petals 4, in unequal pairs, with scales above the base. Disc unilateral, almost reduced to two glands opposite the lower petals. St. 8 excentric, sometimes connate at base, 4 shorter. Capsule 3-celled, inflated, loculicidal, with 3 membranous valves. Seeds globose, usually arillate at base, cotyledons large, transversely conduplicate.

1. **C. halicacabum,** *L.* Galphul, *Kharw* ; Lataphatkari, Sibjhul, *Beng.*

An annual wiry herb, thinly pubescent or nearly glabrous with much acuminate leaflets. Fls. white, ·12″ diam. Capsules depressed pyriform, winged at the angles.

Common, probably in all districts. Fls., Fr. May–Nov.

The root is said to be emetic, laxative and stomachic, and is used in combination with other drugs in rheumatism, nervous diseases, etc.

2. ALLOPHYLUS, *L.*

Small trees or shrubs with 1–3-foliolate leaves and small polygamous irregular flowers in simple or branched racemes. Sepals 4 in unequal opposite pairs, imbricate, hooded. Petals 4 small or almost obsolete, generally declinate, often with a shaggy scale inside. Disc unilateral with usually 4 glands opposite the petals. Stamens 8. Ovary usually 2-lobed and -celled. Ovules ascending, 1 in each cell. Fruit indehiscent 1–2-lobed, dry or fleshy. Seeds usually with a short aril. Embryo curved.

1. **A. serratus,** *Radlkofer* (*Ueber die Gattung Allophylus,* etc., 1909). Syn. A. Cobbe, *Blume* (in part), Kandakola, Kontakura, *Or.*

A shrub erect 3–4 ft. high or much larger and with a straggling habit among other bushes, with 3-foliolate leaves, elliptic or obovate shortly acuminate dentate-serrate or crenate-denticulate leaflets 3–4″ long by 2–2·5″ and irregular small yellowish or white flowers clustered on simple axillary racemes 3–5″ long. Drupels globose, ·25″ diam., orange-red.

Balasore to Puri, common! Fls. June–July. Fr. Sept.

Twigs white or grey, very lenticellate. Lflts. thinly hairy both sides with 6–10 prominent, often opposite sec. n., each nerve ending in a tooth. Petiole 2·5″. Lateral petiolules very short. Racemes very pubescent. Petals somewhat declinate, cuneate, woolly in the centre.

A very variable plant, the Orissa plant belongs apparently to the forms *racemosus* and *serratus* of A. Cobbe of the *F.B.I.* distinguished as follows:

"Racemes simple and solitary, petals somewhat declinate, lflts. oval or ovate, glabrescent or somewhat hairy.

"Lflts. crenate-dentate. Bracts short . . . . *racemosus*.

"Lflts serrate-denticulate. Bracts subulate . . . . . . *serratus*."

Roxburgh says that the ripe berries are eaten and the root is astringent.

3. ERIOGLOSSUM, *Blume*.

Trees with odd pinnate leaves and irregular flowers in terminal panicles. Sepals 5 orbicular, concave. Petals 4, each with a 2-fid scale. Disc fleshy unilateral. St. 8–9. Ovary stipitate 3-lobed. Fruit of 1–3 fleshy oblong diverging cocci. There are only two species of which one is Indian.

1. **E. rubiginosum**, *Bl.* Syn. E. edule, *Bl.*; Sapindus rubiginosa, *Roxb.*; Sona Mahanga, Nunga, *Or.*

A small tree with golden or rusty tomentose pubescence on the twigs and rhachis, pinnate leaves with about 6 pairs opp. or sub-opp. leaflets and occasionally an odd terminal leaflet and small irregular white or pinkish flowers ·25″ long clustered on the racemiform branches of a terminal panicle 8–12″ long. Anterior petal absent. Fruit of 1–3 black fleshy oblong carpels ·7″ long.

Cuttack, evergreen forests of the delta! Mayurbhanj, Similipahar forests! Mals of Orissa! Fls. April–May. Fr. May. Evergreen.

Bark usually discoloured, blaze thin dark red. L. rhachis 5–11″. Lflts. sometimes alternate, 9–13, small 1–3″ and ovate at base of rhachis increasing in size upwards, largest 4–7″ (3–15″ *F.B.I.*) oblong or ell.-oblong, acuminate, base of lateral lflts. usually very unequal, both sides fulvous hairy, especially on the nerves, more or less glabrescent above; sec. n. 8–11, not quite uniting with the marginal nerve, very reticulate between. Branches of panicle 2–5″. Fls. tomentose. Bracts slender villosely tomentose. Calyx sub-globose 5-partite. Sep. unequal rounded hairy ·15″ concave and very imbricate in bud. Pet. 4, ·2″, ell. oblong, long-clawed, each with a large fleshy 2-lobed scale bearded on the inner face of its expanded top. St. 8 (or 9, 1 being forked), three posterior inside the fleshy one-sided lobed disc. Fil. sparsely hairy. Ovary and young fruit villous deeply 3-lobed. Style declinate. Ripe carpels only connate at base, red then black.

The fruit is eaten. *Roxburgh* says the wood is very useful, strong and durable and chocolate-coloured towards the centre. He describes it as a large tree in the Circars. *Gamble* gives the weight as 34 lb. only.

4. LEPISANTHES, *Bl.*

Trees or shrubs with paripinnate leaves and entire opposite leaflets. Flowers irregular (in our species), polygamous, in racemes or panicles. Sepals 5–4 imbricate, outer smaller. Petals 4–6, 1–2 sometimes small, clawed, with a two-lobed often crested ligule near the base. Disc regular or irregular and lobed. Stamens usually 8. Ovary excentric or not, 3-gonous. Ovule one erect in each cell. Fruit 3-celled and 3-gonous coriaceous and tomentose, hirsute within. Seeds oblong, exarillate (always ?), hilum linear, testa thick; cotyledons fleshy, obliquely superposed.

1. **L. tetraphylla**, *Radlk.* Syn. Sapindus tetraphyllus, *Vahl.* (1794); Molinœa canescens, *Roxb.*; Hemigyrosa canescens, *Thwaites*; Panikusum, *Or.*

A small usually crooked tree up to about 3 ft. girth with thick gnarled twigs, glabrous leaves with only 2 pairs of leaflets (1–4

pairs *F.B.I.*), 4–8″ long and copious spiciform panicles, both axillary and from the old leaf axils, of smallish white irregular flowers with erect petals.

Mals of Orissa, rather local! Fls. April. Fr. April-May. Evergreen.

Bark light coloured, blaze rather soft, thick, pale brown. Young twigs pale pubescent. Petiole and rhachis together 3–6″ or more rarely 8″ long, slender, nearly white. Lflts. coriaceous, very variable, either narrowly oblong, 3–7″ by 1–2″ or even smaller with cuneate base, or elliptic-oblong 4–8″ by 2·5–3·4″ with sub-cordate base, acute or rounded, glabrous, mid-rib prominent. Sec. n. 6–12 oblique and inarched at the margin ultimately confluent with a marginal nerve, shorter intermediate soon reticulate with the tertiaries. Petiolules ·15–·4″ glabrous or pubescent, young yellow tomentose. Racemiform panicles 1–2·5″ or elongating to 4–5″ often fascicled, mostly from the old wood, dense-flowered nearly to base, rhachis tomentose. Fls. ·25–·3″ sometimes ·4″ long, fascicled. Sep. 5, orbicular or orbic.-oblong connate at base, 2 posterior largest ·18″ with membranous margins, 2 anterior smallest ·1″. Pet. usually 4 but up to 6 oblong, villous below and with a villous ligule half as long, ligule 2-lobed with a further linear forked appendage on its back exceeding the ligule, both petal and ligule sometimes toothed. Disc anterior. St. 8 hypogynous, within the disc, the posterior at base of calyx, fil. short base thicker, villous. Ovary villously tomentose, obscurely 3-gonous not eccentric, tomentose style and stigma somewhat declinate with 3 stigmatic confluent surfaces not *lobed*. One erect ovule in each cell with rudimentary aril. Fruit ·8″ (ripe?) coriaceous yellow tomentose obtusely 3-angled, cells hairy inside.

5. SCHLEICHERA, *Willd.*

Trees with paripinnate leaves and few pairs of opposite or sub-opposite leaflets. Fls. small, regular, polygamo-diœcious, fascicled on the rhachis of simple or branched racemes, pedicels slender. Calyx small cupular, 4–6-lobed. Petals 0. Disc annular glabrous wavy. St. 4–8 with slender filaments. Ovary ovoid glabrous (or a villous pistillode in male) 3-celled narrowed to the rigid style, stigma lobed. Fruit usually 1-celled, toughly coriaceous, indehiscent. Seed erect with a fleshy aril. Seeds smooth, the large embryo curved round a septum in the seed and the radicle in a fold of the testa, albumen thin or 0 in the ripe seed, cotyledons oblong fleshy, unequal, plumule hairy. Germination epigeal.

1. **S. trijuga,** *Willd.* Kasma, Kusum, *H., Kharw.*; Swad Kusum, *Or.*; Baru, *K., S.*

A handsome dense-foliaged large tree with leaves 8–16″ long, 2–4 pairs of opposite entire leaflets 3–10″ long, the basal ones smallest, and inconspicuous greenish-yellow flowers in numerous lateral racemes, which are often panicled in the male and appear with the new foliage which is coloured a fresh green or deep red. Fruit 1–1·5″ with a sharp point and often somewhat muricate.

In the Northern Tract it occurs in Bettiah but I have no note of its being wild in either the Ramnagar Hills nor in Purneah. It is often planted in the Gangetic plain but its real home is rather in the hilly parts of the Central and Southern tracts where it is frequent in the forests. Fls. Feb.–Mar. Fr. July–Aug. Nearly or quite evergreen.

Attains 7–8 ft. girth but not a great height. Bark rather thin, blaze pink, slightly mottled yellow darkening to brown. Leaves dark green with rhachis 3–6″ long, leaflets sessile ell. or oblong glabrous, very rarely repand or sub-lobed, with 10–16 slender distinct pale sec. n. and intermediate shorter ones finely reticulate between. Inflorescence tomentose. Racemes 2–6″, axillary or below the leaves and often on special abbreviated branchlets. Filaments glabrous or slightly hairy, finally ·15″ long. Seed compressed, brown, ·6″ long. Cotyledons in the seedling oblong 1–1·5″ long; first leaves opposite and 3-foliolate.

The timber is good but the tree is rarely cut, being left for the cultivation of lac. The large branches are cut off in the Santal Parganahs for axles. Sugar presses and oil mills are made from it. *Gamble* gives the weight of the wood as about 68 lb. and P = 980, and he states that it seasons well and takes a good polish. The lac grown on it obtains twice the price of that grown on any other tree. Mr. Cooper states that the Kalahandi State alone obtains some Rs. 50,000 for monopoly fees for the right to cultivate. I have suggested that the tree should be extensively grown as a shade tree along fire lines as it is in leaf in the hot weather and lac cultivation could be easily watched. It is readily raised from seed sown as soon as ripe. The young plants should be put out in one year from the time of sowing. The average of 13 trees sown by me in Singbhum was after 16 years 23·5 ft. high and 14·5″ girth,* the largest 23″ girth.

Both the aril and the kernel of the seed are eaten and a good oil for cooking is expressed from the seed. *Campbell* says that the oil is used for the treatment of certain skin diseases. It is also reputed to be the original Macassar Hair Oil.

6. NEPHELIUM, *L.*

Trees or shrubs with paripinnate leaves and entire sub-opposite leaflets. Fls. small regular polygamous racemed or panicled. Calyx cupular 4–6-lobed, open or closed in bud. Petals 4–6 or 0, small rarely squamate. Disc annular. Stamens 6–8, filaments slender. Ovary pubescent, often verrucose, 2–3-lobed and -celled. Fruit of 3–1 indehiscent globose often tubercled thinly crustaceous cocci. Seeds with a succulent aril.

1. **N. litchi,** *Camb.* Vern. Litchi (Chinese).

A demi-foliaged tree, often flowering in a dwarf state, with pari-pinnate leaves, two to six pairs of glabrous shining oblong lanceolate or ovate acuminate leaflets 2–6″ long and small greenish-white or yellow flowers in pyramidal panicles, polygamous. Ovary 2-lobed compressed silky, only one lobe usually developing in fruit. Ripe fruit (coccus) with dry brittle tubercled pericarp. Seed one with large fleshy aril.

Everywhere cultivated ! Fls. Feb.–March. Fr. May–June. Evergreen.

Lflts. coriaceous, sec. nervation obscure. Calyx cupular shallowly toothed. Cor. 0. St. incurved in bud, straight erect far exserted. Style in fertile fls. with 2 recurved lobes but most of the fls. are male with undivided style.

Requires a lot of water to grow well.

2. **N. longana,** *Roxb.* Ashphal, *Beng.* Longan (Chinese).

A large or small tree with a more distinct trunk than in the preceding and large bushy crown. Lflts. 2–5 prs. opp. or alt. ell. ovate oblong or lanceolate subacute or obtuse 2–8″ long, shining above, rather glaucous and often slightly pubescent beneath. Fls. yellowish, tomentose, in panicles 10–15″ long with long branches. Calyx closed in bud with imbricate ovate sepals. Petals 5–6 clawed and filaments hairy. Fruit of 1–2 cocci. Pericarp brown, rather rough but not acutely tubercled. Aril less thick and succulent than in the *Litchi*.

Frequently cultivated, but less common in European gardens than the *Litchi*. It is said to be indigenous in India but is not so in this province. Fls. March–April.

7. SAPINDUS, *L.*

Trees or shrubs with pari-pinnate leaves and entire opp. or sub-opp. leaflets. Fls. small regular panicled. Sepals 5 imbricate, in

* Measurements kindly taken by Mr. A. N. Grieve in 1917.

two series, unequal. Petal 4–5, sometimes squamate. Disc annular lobed. Stamens normally 8, filaments free, usually hairy. Ovary entire or 2–4-lobed, 2–4-celled or reduced to a villous pistillode in the male with usually 3 styles. Fruit of 1–3 fleshy or coriaceous drupaceous cocci, pericarp saponaceous. Seeds usually globose with two integuments, the outer very hard, the inner membranous. Cotyledons spirally convolute linear oblong unequal. Germination epigeal.

Lflts. broadly oblong or elliptic, obtuse or emarginate . . . 1. *emarginatus.*
Lflts. obliquely ovate-lanceolate acuminate, glabrous . . . 2. *trifoliatus.*

1. **S. emarginatus,** *Vahl.* Syn. S. trifoliatus, *Hiern* (*F.B.I.*) in part; Bor-ritha, *Beng.*; Muktamanji, *Or.*; Rentha, *Or.* (f. *Cooper*).

A dense dark-foliaged tree with pari-pinnate leaves and 2–3 prs. of broadly-oblong or elliptic, sometimes somewhat obovate, obtuse or emarginate, not shining leaflets 2·5–6″ long, pubescent beneath with strong sec. n. and reticulations, and white flowers ·15–·2″ long in rather dense terminal panicles shorter than the leaves. Pet. 5 long-clawed, lanceolate, ·15″ long, densely yellow-hairy outside and white fringed, glabrous within or sometimes *distinctly hairy* near the middle and with two inflected woolly tufts on the margin (representing the scale ?). Ovary densely ferruginous-tomentose. Fruit of 2–3 drupels, yellow-brown, ·7″, glabrescent, wrinkled when ripe.

Not wild north of the Orissa Mals, where it is doubtfully so! Frequently cultivated in the south of the province! Occasionally cultivated in Chota Nagpur, Gaya, etc.! Baud, Palahara cult. *Cooper.*

Fls. Nov.–Jan. Fr. March–May. Evergreen.

Young parts tomentose. L. rhachis with petiole 2–5·5″ tomentose or pubescent. Lflts. with rounded base, often shining above (Gamble says dull above), lowest pair smallest, sec. n. 7–10 running close to margin and reticulating with the marginal nerve, tertiaries very reticulate and raised both sides. Petiolules ·1–·25″. Panicles 3–4″. Sep. 5 oblong or ovate, tomentose. Petals 5, long-clawed, lanceolate. Stamens woolly. Unripe fruit undivided tomentose. Seed in each drupel round smooth.

The tree is easily grown from seed sown in June (with the pericarp). The expanded cotyledons are ·75″ long, oblong-linear, fleshy, petioled. Hypocotyl rather stout, 2″ long, young stem and petiole of first leaves pubescent, first leaves 3-*foliolate*, lflts. elliptic but lanceolate both ends and *very acute*, rather coriaceous hairy beneath, reticulate, about 2′ long, lateral shorter. Petiole ·3″. The pericarp is very saponaceous and is used for soap.

2. **S. trifoliatus,** *L.* Syn. S. trifoliatus, *Hiern* (in part); S. laurifolius, *Vahl.* (*vide Kew Bull.*, No. 7, 1920, p. 250). Vern. names of last.

A tree somewhat resembling the last and considered by some to be merely a variety of the same species. The leaflets are, however, obliquely ovate-lanceolate or lanceolate or elliptic-oblong and *acuminate*, rarely only acute or obtuse, more shining above and glabrous or nearly glabrous beneath, sec. n. 8–10, not very distinct from the intermediate. Petals lanceolate equally woolly *all over the inside* except on the claw, scale 0 or minute. The fruit is velvety ferruginous and not glabrescent and is divided less than half-way down into upright drupels (I am not sure however that these are perfectly ripe).

Only occasionally planted in our area.

8. APHANIA, *Blume.*

Trees or shrubs with simple, 1-foliolate or pari-pinnate leaves and regular polygamous small flowers in terminal and axillary panicles. Sepals 4–5 widely imbricate. Petals 4–5, sometimes squamate, scale 2-fid. Stamens 6–8 neither unilateral nor declinate. Ovary entire or 2–3-lobed, 2–3-celled. Fruit of 1–3 oblong or ellipsoid drupels only united at the base. Seed with crustaceous or membranous testa, sometimes arillate, embryo with thick cotyledons.

1. **A. danura,** *Radlk.* Syn. Scytalia Danura, *Roxb.*; Sapindus Danura, *F.B.I.*; Danura, *Beng.*

A shrub in the form usually of a miniature tree about 10 ft. high or less with a crown of large oblanceolate or broadly lanceolate sub-sessile simple leaves with a broad sub-cordate or cordate base and terminal panicles 4–6″ long of numerous small pedicelled pale pink flowers. Drupels 1–3, usually only 1 maturing ellipsoid ·45–·5″ with soft endocarp and one large seed.

Mals of Orissa, usually in glades in the forest! Fls. March. Fr. April.

Stems slender. L. 6–13″ by 1·75–4″, long-acuminate glabrous tapering to the broad base, sec. n. 12–16 with shorter intermediate, tertiaries much reticulate, margin thickened. Petiole stout ·4–·5″. Panicle with short spreading branches. Fls. not clustered. Sep. 5 unequal orbicular. Pet. 5 each with a short bifid woolly scale near the base. St. 6–8. Disc crenulate glabrous. Ovary 2–3-lobed. The fruit turns from orange through bright scarlet to black when quite ripe.

9. HARPULLIA, *Roxb.*

Trees with odd- or even-pinnate leaves and alternate leaflets. Fls. large (for the family), regular or sub-regular, polygamous or poly.-diœcious, in racemes and panicles. Sepals 4–5 imbricate in two series. Petals 4–5, oblanceolate or obovate, without scales. Stamens 5–8 hypogynous. Disc hardly any but torus raised under the ovary which is reduced to a villous pistillode in the male. Ovary tomentose 2 (rarely 3)-celled and -angled. Ovules 2 in each cell axile. Fruit a coriaceous inflated 2 (-3)-lobed and -celled loculicidal capsule. Seeds 1–2 in each cell horizontal ellipsoid or subglobose, more or less arillate. Albumen 0, embryo very large of 2 semi-spherical unequal cotyledons with radicle incumbent and directed towards the hilum in a fold of the testa. Germination hypogeal.

NOTE.—There appears to be no safe character in the twisting of the stigma. *Mr. Hole* in examining my specimen kindly pointed out that *Beddome* referring to *H. imbricata* says that the style is short or elongated and stigma sometimes not at all twisted, though both *Thwaites* and *Cook* emphasise the importance of the style being 3–4 times as long as the ovary and the stigma oblong and spirally twisted. *Hiern* is perhaps correct in reducing *H. imbricata* to (a variety of) *H. cupanoides*, *Roxb.*, but as I do not know the latter tree in the field I keep it distinct.

1. **H. imbricata,** *Thwaites.* Syn. H. cupanoides, *F.B.I.* (in part); Phutika, *Or.*

A tree up to about 4 ft. girth and of considerable height with long clear bole, stout closely lenticellate pubescent twigs and im-paripinnate leaves but terminal lflt. often rudimentary. Lflts. 8–13 mostly alternate ell. or ell.-oblong acuminate with oblique base. Fls.

large pale yellow in lax racemiform panicles 2·5–5″ long extra-axillary and below the leaves on the old or new shoots. Fruit loculicidally dehiscent coriaceous scarlet inflated 1·7–2·5″ diam. 2 (-3)-lobed and -celled. Seeds ell.-oblong or ellipsoid with short thick funicle and a rudimentary aril.

Mals of Orissa, near streams, rare! Fls. April-May. Fr. July-Aug. Nearly evergreen, the new leaves appearing at the time of flowering while some of the old leaves are still on the tree.

Bark very light coloured. Blaze with chlorophyll, moderately hard, pale brown, white within. Hairs both simple and stellate. Shoots fulvous pubescent or tomentose. L. rhachis 8–16″ pubescent, lflts. 5–8″ with smaller ones at base, pubescent on the nerves, sec. n. 8–11 looped and united within the margin. Petiolule ·3–·4″. Fls. ·75″ diam. Sep. 5, free. ·4″ long, oblong or obovate with rounded tip, tomentose. Pet. 5 clawed, ·8″, oblanceolate with involute crisped margins, sparsely stellate-hairy. St. 5–6, hypogynous, ·6″, anthers oblong basifixed. Disc practically *nil*, but torus densely villous pubescent raised under the ovary. M. fls. with villous pistillode and rudimentary style. Ovary minute flattened 2 (-3) -celled villous, style minutely 2-fid with flattened lobes. Ovules 2 in each cell axile. Capsule 1·2–1·5″ long, transversely oblong, with very shortly stipitate base, permanently tomentose at the base. Seed 1, rarely 2, in each cell, horizontal ·6–·8″ (never sub-globose as described in *F.B.I.*), hilum basal. Testa smooth black shining. First leaf solitary *4-foliolate*.

A very ornamental tree in fruit, from the scarlet capsules.

10. DODONÆA, *L.*

Shrubs or small trees with alternate simple leaves and small polygamous or poly-diœcious flowers in lateral and terminal cymes. Sepals 2–5 imbricate or valvate. Petals 0. Disc 0 in male, small in herm. fls. Stamens 5–10 inserted on the outer side of the disc where present. Ovary 2–6-angled and -celled. Ovules 2, rarely 1 in each cell. Fruit membranous or coriaceous, septicidally 2–6-valved, valves winged. Seeds without arillus, subglobose or lenticular. Embryo normal.

1. **D. viscosa,** *L.* Mehndi, *Vern.*; Mohara, *Or.*

A light green resinous shrub attaining 10 ft. high with simple alt. oblanceolate glabrous sub-sessile leaves 1–3·5″ long and short axillary and terminal cymes of green flowers. Fruit membranous 2–4-winged, septicidally 2–4-valved.

Cuttack and Puri, near the sea, possibly wild! Plentiful in the Bajaragarh reserve, Kalahandi, *Cooper*. Often cultivated.
Fls. Nov.–Feb. Fr. Oct.–Nov.

Sub-gregarious where wild. L. coriaceous shining as though varnished, tapering into a short petiole. Sec. n. many. Fls. regular, polygamous long-pedicelled. Sep. 4–5 spreading ·1–·12″. Pet. 0. St. 8. Disc inconspicuous. Ovary 3–4-celled. Ovules 2 in each cell. Fruit ·5″ long. Seeds sub-globose, nearly black with a thickened funicle. Embryo spiral.

FAM. 50. SABIACEÆ.

Trees or shrubs, sometimes scandent, with alternate simple or pinnate exstipulate leaves. Fls. small, sometimes polygamous, with 5–3 sepals and petals or apparently only 3 petals with two others reduced to scales. Stamens as many as the petals and opposite to them but frequently only two fertile and the others variously modified, inserted on or at the base of the disc. Ovary superior

free, usually surrounded at the base by the usually small toothed or lobed disc, 2- rarely 3-celled, sometimes 2-lobed. Ovules 2 (rarely 1) in each cell, axile, horizontal or pendulous, superposed, epitropous. Style short or 0. Fruit drupaceous and 1-seeded or of 2–3 drupels. Albumen 0, cotyledons conduplicate with long often spiral hypocotyl.

Shrubs, often climbing, with 4–5 perfect stamens . . . . . 1. *Sabia.*
Trees, with 3 stamens reduced to staminodes . . . . . 2. *Meliosma.*

1. SABIA, *Colebr.*

Climbing or sarmentose shrubs; branches with the bud-scales persistent at their bases. L. simple entire, sec. n. short, soon branched, and venation very reticulate. Fls. small axillary solitary or panicled 2-bracteate. Bracts, sepals and stamens all opposite. Calyx 4–5-partite. Petals 4–5. Disc annular, 4–5-lobed. St. inserted at the base of the disc. Carpels 2 (-3) slightly cohering, gibbous and usually drupaceous in fruit with sub-basal style. Styles as many as carpels slightly cohering. Ovules 2 in each carpel, collateral or superposed. Seed reniform, testa coriaceous, dotted. Embryo curved.

1. **S. paniculata,** *Edgew.*

Sarmentose shrub. Branchlets glabrous or young somewhat hairy. L. glabrous coriaceous 6–8″ by 2–3″ elliptic or ell.-oblong shining above. Panicles long hairy. Fls. yellowish. Petals oblong or ovate-oblong, ·05–·07″ (·08–·12″ f. *F.B.I.*). Drupels ·3″.

Ravines in the Sameshwar Hills (N. Champaran). Elev. 2000 ft.! Fls. Jan.–Feb. Fr. Feb.–March. Evergreen.

Stems up to 1″ diam. L. with rounded base, apex slightly tapering or not. Sec. n. about 4–5, soon branched and with shorter intermediate, venation slightly raised above when dry. Petiole rather stout, ·6–1″, often with transversely elongated lenticels at the base.

2. MELIOSMA, *Blume.*

Trees or shrubs with simple or odd-pinnate leaves or sometimes even-pinnate, sometimes serrate or only serrate when young. Fls. 2-sexual panicled with small bracteoles which pass into the sepals and are persistent with them. Petals 5, with the two innermost more or less ligulate, often 2-fid and scale-like, the outer very concave and imbricate. Stamens with the three opposite to the outer petals reduced to staminodes, inner two more or less adnate at base to the inner petals. Fruit a small obliquely globose drupe, 1-seeded.

1. **M. simplicifolia,** *Walp.* Syn. Millingtonia simplicifolia, *Roxb.*; Churri, *Nep.*

A small tree with large simple oblanceolate entire shining leaves 6–12″ by 1·75–4·5″ and rusty pubescent panicles as long as the leaves of small yellowish-white flowers. Drupe small keeled, ·17″–·2″ diam.

Bettiah and Sameshwar Hills, along watercourses! Deep ravines with a perennial water supply in the Saranda forests of Singbhum, especially above 1000 ft. elev.! Fls. Dec.–March. Fr. March–June. Evergreen.

Twigs with prominent lenticels, puberulous. L. glabrescent and shining both sides, sometimes obovate, acuminate, base tapering into a slender pubescent petiole 1–1·5′ long which is thickened at the base. Sec. n. 12–16 prominent oblique curving up inside the margin. Fls. minute sessile. Sep. 3–4 larger and 2 (bracteoles?) smaller, ciliate. Pet. 3, outer large orbicular concave, the two inner bifid scale-like.

Gamble says that the wood is reddish and moderately hard with a pretty silver grain but warps. Wt. about 33 lb.

FAM. 51. ANACARDIACEÆ.

Trees or shrubs with resin canals in the twigs and pericarp and usually with acrid resinous sometimes milky juice. Leaves alternate, rarely opposite, simple to odd-pinnate, often of hard texture, exstipulate, venation normally of rather numerous and strong sec. n. meeting by loops or reticulations in the margin. Fls. small regular (or sub-irregular in andrœcium and gynœceum) 2-sexual or diœcious or polygamous, often panicled. Calyx sometimes sub-perigynous, 3–5-sepalous usually from a shallow hypanthium lined with a disc free at its margins. Corolla 3–5-petalous, imbricate or sub-valvate. Stamens diplostemonous or reduced in number, rarely only one fertile, inserted under the margin of the disc or on it. Ovary superior or half-inferior of 1 or 3–6 free or more or less connate carpels forming a 1- or 3–5-celled ovary. Ovule 1 only or 1 in each carpel, pendulous, anatropous, pendulous from an ascending basal funicle or lateral or sub-apical, rarely axile, raphe dorsal (turned to the outside of the carpel). Fruit a 1–5-celled, usually a 1-celled and 1-seeded drupe which is often oblique. Endocarp sometimes ultimately dehiscent, albumen 0 or scanty. Embryo large and fleshy, often curved. Germination usually hypogeal, sometimes epigeal.

A. Carpel one. St. 10–5, only 1–4 fertile. Leaves simple.
  Large trees. Fruit a succulent drupe (Mango) . . . 1. *Mangifera.*
  Small tree. Fruit dry on a succulent hypocarp . . . 2. *Anacardium.*
B. Carpels 4–6 but only 1 fertile, all free.
  Trees. Leaves simple. Frt. a small drupe . . . . 3. *Buchanania.*
C. Carpels 3 united into a 1-celled 1-ovuled ovary.
  1. L. simple. Ovule pendulous from near top of ovary.
    Fls. 4-merous. Fruit not sunk in a fleshy cup . . . . 4. *Nothopegia.*
    Fls. 5-merous. Fruit sunk in a fleshy cup . . . . 5. *Semecarpus.*
  2. L. usually 3-more foliolate. Ovule on a basal funicle . . 6. *Rhus.*
D. Carpels 4–5 united into a 1–5-celled ovary. Styles 4–5. Ovules from top of cell. Leaves pinnate.
  Only 1 cell and seed developing. Fls. in simple or branched racemes. Drupe small compressed . . . . 7. *Odina.*
  Several cells with their seed developing. Fls. in erect panicles. Drupe large, ellipsoid ... . 8. *Spondias.*

1. MANGIFERA, *L.* Mango.

Trees with small polygamous flowers on articulate pedicels in terminal panicles. Sepals and petals small spreading. Stamens only 1–2 usually perfect, inserted on the inner side of the tumid lobed disc, staminodes often minute. Ovary sessile 1-celled oblique with infra-terminal style and one ovule pendulous from a sub-basal funicle. Drupe large with fleshy and fibrous mesocarp. Germination hypogeal.

1. **M. indica,** *L.* Uli, *K.*; Ul., *S.* (the fruit, amsi); Am, *H.*; Ambo, *Or.*

This, the common mango, is very similar to the cultivated one but is a fine large tree attaining 70 ft. and up to 8 ft. girth or more. The fruit is 3–4″ long with a very large stone, thin epicarp and very abundant pleasant juice but little flesh in the mesocarp.

There is no doubt that it is indigenous over a great part of the province as well as cultivated everywhere except by some of the aboriginal races. It still occurs wild in the ravines of the Sameshwar Hills and along rocky valleys and banks of streams in the deepest jungles of Chota Nagpur and Orissa, also apparently in the Santal Parganas and on the higher mountains.

Fls. Jan.–March. Fr. May–June. Evergreen, new leaves mostly in June.

The wood is chiefly employed for the manufacture of indigo and opium chests, and for packing cases. The wild mango is an important article of food to the aboriginal tribes, especially in times of famine. Large baskets of it are collected, it is boiled and the liquid drunk and the kernels after being steamed are also eaten. These however contain some 10 per cent. of tannic acid and they are indeed sometimes used on this account in cases of diarrhœa, so that they must be very unwholesome!

The tree is easily grown from seed, best sown *in situ* as soon as ripe. On germination the endocarp splits into two valves. It does not thrive in very dry localities, and is sometimes partly deciduous in such places where not protected by neighbouring trees.

2. ANACARDIUM, *Rottb.*

1. **A. occidentale,** *L.* Hijali-badam, *Beng.*; Kaju, *H.*; Lanka-Ambo, Bajan, *Or.*; Balia (Sambalpur). The Cashew-nut.

A small crooked tree often branched along the ground with simple alternate coriaceous obovate leaves 3–7″ long and terminal and upper-axillary pubescent panicles much longer than the leaves, of pink somewhat irregular flowers ·3–·4″ long. After flowering the top of the pedicel and torus enlarge into a clavate and ultimately pyriform fleshy body 2–3″ long on which is seated the kidney-shaped nut ·8–1″ long.

Very commonly planted in Orissa near the coast, and running wild in some parts of the Mahanadi delta! Introduced from America. Fls. March–April. Fr. April–May.

Bark rough. L. with rounded or emarginate apex. Panicles and its branches long-peduncled with numerous lanceolate or ovate bracts ·25″ long. Fls. polygamous. Pedicels very short. Sep. 5 nearly free ovate or lanceolate ·17″. Pet. 5 linear subequal (2 posterior rather shorter) ·32–·4″ recurved. St. 1, far exsert, 7–8 others included, inserted on the short disk. Ovary obovoid nearly regular, style as long as the long stamen somewhat curved, stout with small capitate stigma, ovule 1 pendulous from a lateral funicle near the top of the ovary, anatropous, upcurved.

I can find no justification for stating that the large "hypocarp" is formed of either the accrescent "disc" (*F.B.I.*, etc.) or the enlarged calyx-base (*Brandis*) in addition to the torus. Indeed it is open to question whether there *is a disc*, the stamen being merely connate into a short tube at the base easily detachable from the torus and slightly adnate to the base of the petals.

The tree grows well in pure sand and is being used in the Casuarina plantations at Puri. The hypocarp and the seed are eaten. The former is very astringent unless perfectly ripe, when it is very pleasant. The seeds are usually roasted. The pericarp of the fruit is full of oil glands which contain the same active principles as are found in *Semecarpus anacardium* (*q. v.*). The kernels when pressed yield a light yellow bland oil which is nutritious and emollient. Gamble says that the growth shows about 8–11 rings per inch of radius; the wood is reddish-brown, moderately hard, and can be used for packing-cases and for charcoal. Wt. 30–38 lb. In the Andamans the oil from the pericarp is used to colour and *preserve fishing-lines.*

3. BUCHANANIA, *Roxb.*

Trees with alternate petioled simple entire leaves and small white 2-sexual flowers in dense axillary and terminal panicles. Calyx 3–5-toothed or -lobed, imbricate, persistent. Petals 4–5. Disc swollen 5-lobed. Stamens 8 or 10 inserted at the base of the disc. Carpels 5-6 of which only one is perfect, style short, stigma truncate. Ovule 1 pendulous from a basal funicle. Fruit a drupe with crustaceous or bony 2-valved endocarp. Seed gibbous, acute at one end with thick cotyledons.

1. **B. latifolia,** *Roxb.* Tarub, *K.*; Tarop, *S.*; Piar, Pial, *Kharw., H.*; Char, Achar, *Khond.*

A small straight tree with rough bark, stiff entire strongly nerved oblong or ovate-oblong leaves 6–10″ long and dense pyramidal panicles of white flowers ·2–·25″ diam. Drupes globose black ·5″ diam.

Northern area rather scarce, Champaran! Bhagalpur! Central and Southern areas very common, especially in the hilly tracts and towards the west.

Fls. Jan.–March. Fr. April–May. Nearly evergreen but sometimes leafless in April or May in dry years. New leaves in June.

Bark dark grey or black with oblong bosses. Innovations pubescent or villous. L. pubescent beneath rounded at the tip, nervation very similar to that of *Semecarpus* but without the grey or white felt between the nervules. Petiole ·25–·3″, stout pubescent. Panicles densely pubescent. Sepals 5 nearly free. Petals triangular or oblong. Stamens erect as long as the spreading petals. Carpels hairy.

The wood is not much used but the fruit is largely eaten. The flesh is very palatable and the kernels, somewhat like Pistachio nuts, are used in sweetmeats. "They fetch Re. 1/- per seer in the Calcutta market from some of the Orissa States" (*Cooper*).

4. NOTHOPEGIA, *Blume.*

Small trees with alternate or opposite petioled entire leaves and small bracteate white or greenish polygamous flowers in short axillary racemes. Calyx 4–5-lobed persistent. Petals 4–5 spreading imbricate. Stamens 4–5 alternate with petals inserted on or under the margin of an annular 4–5-lobed disc, filaments free hairy. Ovary free sessile ovoid 1-celled with very short curved style and capitellate stigma. Ovule 1 pendulous, from a thick funicle from near the top of the ovary on the side to which the style is inclined. Drupe sub-baccate, somewhat oblique, pericarp often with large glands. Cotyledons thick, albumen fleshy.

1. **N. Heyneana,** *Gamble.* Syn. N. Colebrookiana, *Blume,* var. Heyneana, *J.D.H.*

A small tree with rusty hairy twigs and densely ferruginous buds, alternate narrowly oblong acuminate leaves 3–6·5″, whitish beneath, with 15–20 raised sec. n. meeting the marginal one, minutely reticulate between. Fls. 4-merous small greenish in very short rusty racemes or sub-solitary. Fr. 1-seeded, ·2″ diam., globosely obovoid, red, somewhat oblique, vertically striate when dry. Seed transversely oblong.

Mals of Puri, rare! Top of Mailgiri, 4000 ft., *Cooper*! Fls. March–April. Fr. April–May. Evergreen, new shoots April–May.

Bark smooth, blaze deep red. L. with lanceolate base, margins sometimes wavy. Petiole slender ·3–·5″. Racemes ·2″ or less, pedicels swollen, longer than the subulate bracts. Calyx lobes 4 nearly free, ovate, spreading, rusty pubescent. Petals

free small, erect, lanceolate-ovate or oblong, ·15″ long with recurved obtuse tip somewhat hairy. Stamens 4, filaments very short and shortly hairy. Pericarp with large glands. Seed laterally attached by a short thick funicle.

The fruit is baccate in my specimens but possibly becomes drupaceous and blue when quite ripe. The racemes are shorter and the leaves far longer than as described by *Gamble*.

5. SEMECARPUS, *L.f.*

Trees with alternate simple entire coriaceous leaves and small polygamous or diœcious flowers in terminal rarely axillary panicles. Calyx with deciduous sepals on a cupular or shallow hypanthium. Petals 5–6 imbricate. Disc broad annular. Stamens 5–6 inserted at the base of the annular disc. Ovary 1-celled with 3 styles. Ovule pendulous from a sub-apical lateral funicle. Drupe firm or fleshy, oblong or sub-globose, oblique, seated on the fleshy accrescent cupular hypanthium, pericarp full of acrid resin-glands. Seed pendulous with coriaceous testa and somewhat fleshy inner coat. Embryo with thick plano-convex cotyledons, radicle superior.

1. **S. anacardium,** *L.* Soso, *K., S.*; Bhelwa, *H., Kharw.*; Bhela, *Beng.*; Balia, *Or.* The Marking-nut tree.

A small tree with large simple oblong or usually obovate strongly-nerved leaves 8–18″ long clustered at the ends of the branches, and smallish sub-sessile fasciculate dull greenish-yellow flowers ·25″ diam. on the branches of a stout pubescent panicle as long as or exceeding the leaves. Fruit an oblong or obliquely ovoid drupe 1″ long, finally black, seated in the orange cup.

Throughout the whole area, chiefly in the hilly districts, from the Sameshwar hills southwards. Fls. June–Sept. Fr.: I have notes of it ripe and dropping Nov.–Dec. but also notes of it up to March (perhaps a different flowering). The tree is deciduous March–May.

Branchlets stout, young pubescent or tomentose. L. hairy on the nerves beneath and grey between them with a close-felted layer of microscopic papillæ, apex rounded, sec. n. 16–25, reticulate within the thickened margin. Petiole 1–2″. Petals oblong exceeding the small sepals. Ovary tomentose.

The wood is not used as the black caustic juice which exudes from the bark when felled causes blisters to the axe-men. Indeed "it is said to affect one even to walk under the tree, giving swollen eyes" (*Cooper*).

The pericarp abounds in black oily acrid juice which is used for marking cotton fabrics and, with lime as a mordant, is indelible. It contains anacardic acid and cardol and is strongly escharotic and vesicant. The *Sanscrit Materia Medica* and *Indian Plants and Drugs* give various prescriptions but it is not always clear whether the pericarp or seed is intended; thus "the ripe fruits are used internally and are considered digestive, nervine and useful in dyspepsia, piles, skin-diseases and nervous debility." The pericarp also gives one of the active principles in the preparation used by mahouts in "chobing" elephants' feet.

The orange cup is eaten when quite ripe but is a little astringent to the taste. The tree coppices readily from the side of the stool which is soon coloured black.

6. RHUS, *L.*

Trees or shrubs with alternate simple 3-foliolate or pinnate leaves with entire or serrate leaflets. Flowers small polygamous. Calyx 4–6-partite with imbricate sepals. Petals 4–6 spreading. Disc cupular lobed. Stamens 10 or reduced in number, inserted at base of disc with subulate filaments. Ovary sessile usually ovoid or spherical with 3 styles and capitellate stigma. Ovule 1 pendulous from a basal funicle. Fruit a small drupe, sometimes compressed,

with mesocarp full of resin cells and crustaceous or bony endocarp. Seed sometimes kidney-shaped with flat cotyledons and lateral up-curved radicle.

A large genus poorly represented in our area, often abounding in very acrid juice.

1. **R. semialata,** Murray. Bakiamela, *Nep.*

A small pretty tree with impari-pinnate pubescent leaves and 4–6 pairs of opposite sessile oblong or elliptic-oblong crenate or dentate strongly nerved lateral leaflets 2·5–6″ long, smaller at the base of the often winged rhachis, and small white or yellow-green flowers ·08″ diam. in large terminal panicles nearly as long as the leaves. Drupe orbicular compressed, red and shining when ripe, ·3″ diam.

On the top of the Sameshwar Hills 2500 ft.! Fls. April–Sept. Fr. Dec. Deciduous, the leaves turn red before falling. It is a common tree in Nepal and Sikkim but usually above 3000 ft.

Bark rough. Blaze red exuding small drops of milky juice. Twigs, petioles and rhachis closely shortly pubescent. L. rhachis 9–18″ narrowly margined or winged at least towards the end, leaflets shortly acuminate pubescent beneath and slightly so above, midrib tomentose, sec. n. 16–20, many bifurcate towards the tip, each nerve or bifurcation entering a tooth, base of terminal leaflet decurrent on the rhachis. Panicle with subsidiary smaller ones from the upper axils. Sep. ovate, obtuse, pubescent. Pet. larger oblong ciliate and with a ciliate ridge above. Disc cupular, 10-lobed.

The small acid drupes are eaten. Wood not used.

7. ODINA, *Roxb.* Syn. Calesium, Adans.

Trees, usually with thick twigs full of starch and 3–many-foliolate odd-pinnate leaves. Fls. small greenish diœcious or polygamo-diœcious clustered on the rhachis of simple or branched spikes or racemes (spiciform panicles), 4– more rarely also 5-merous. Sepals united into a short tube below. Petals longer, inserted with the diplostemonous stamens just under the margin of the 8–10-crenate or -lobed saucer-shaped disc. Male with deeply 4-lobed pistillode, female ovary 4–6-celled or -lobed or usually 1-celled, each lobe ending in a short stout style and simple papillose or capitellate stigma. Drupe often oblique. Ovule pendulous from near the top of each cell only one developing, or one only in 1-celled ovaries. Drupe often curved and oblique 1-celled (with *f. Engler*, sometimes 2–3 sterile cells, but I do not find this in our species).

1. **O. wodier,** *Roxb.* Nanam, *K.*; Doka, *S.*; Dhauuk, doka, *Tanti*; Jhingan, *H.*; Genjan, *Kharw.*; Jial, Kasmala, *Beng.*; Jhingna, jian, *Th.*; Mai, Mowai, *Khond* (or *Gond* ?); Raji-mohi (Angul) and Mode (in the Orissa States, *f. Cooper*).

A small or large tree with pinnately 5–9-foliolate leaves clustered at the ends of the thick twigs, lflts. 2·5–5·5″ paired, ovate acuminate with oblique base, lower smaller shortly petiolate, upper pairs sometimes sessile, terminal petiolule 1–2″. Flowers small yellowish-green diœcious fascicled on the rhachides of numerous racemes towards the ends of the bare twigs, males usually drooping longer and compound, females at first erect, fls. succeeded by curved oblong compressed drupes ·5″ long.

One of the commonest trees. Throughout the whole area from the Sameshwar Hills and Purneah to the shores of the Chilka Lake and Kalahandi! Fls. March-April. Fr. April-June. One of the first trees to lose and one of the last to regain its leaves, being leafless Nov.-May but seedlings keep their leaves longer. It has chlorophyll under the outer bark.

Bark light-coloured and smooth in young trees, rough and dark in old ones with blaze bright crimson, streaked or flushed pale pink or white. Innovations with scattered stellate hairs or sometimes almost tomentose. Racemes never truly terminal and fruiting below the leaves, males 3–8″, female 3–6″ elongating in fruit. Sepals ovate ciliate. Petals ·12″ oblong acute, or longer and obtuse in female which has eight staminodes and a 4–6-lobed ovary. Drupe with a thin fleshy red epicarp and a large stone seated on the somewhat enlarged calyx ·1″ diam.

The timber of big trees although said to be strong and useful is hardly, if ever, used in the province but *Campbell* says that in Manbhum it is suitable for bobbins. The pith and other tissues contain an abundance of starch which makes it good for elephant fodder and renders it easily grown from cuttings. It yields a gum in considerable quantity which is used in cloth-printing by weavers (*Brandis*) and in medicine. The bark is astringent and gives a coarse fibre. The fruit is largely eaten by birds. It coppices easily.

8. SPONDIAS, *L.*

Trees with alternate odd-pinnate leaves usually crowded at the ends of the branchlets and small or m. s. polygamous flowers in large terminal pyramidal panicles. Calyx and corolla 4–6-merous, sepals slightly imbricate, petals spreading sub-valvate. Stamens 8–10 inserted beneath the broad pulvinate lobulate disc. Ovary sessile 4–6-celled and -lobed above with 4–6 free or connivent styles. Ovule 1 pendulous in each cell. Fruit a large drupe with a 1–6-celled stone. Embryo with elongate cotyledons and superior radicle.

In germination the radicle grows out at the end of the stone which becomes spongy, the hypocotyl, which is very stout, pulls out the long linear cotyledons which become foliaceous. The first leaves are 3-foliolate with the leaflets (in our species) *denticulate*.

1. **S. mangifera,** *Willd.* Amar, *Th.*; Ambo, *Ho.*; Amburu, *Mund.*; Amra, *S.*, *H.*; Amara, *Kharw.*; Ambra, *Beng.*; Katambolam, *Mal. P.*; Ambada, *Or.* Hog Plum.

A large or m.s. tree with stout branchlets and sweet mango-smelling leaves with 4–6 prs. of strong-nerved leaflets 2–9″ long by 1–4″ broad. Fls. white ·25–·35″ diam. sessile in small cymes on the branches of a large panicle 1–2 ft. long when the tree is leafless. These are succeeded by large yellowish plum-like drupes 1·5″ long, ellipsoid.

Throughout the whole area, especially near rivers, wild, and often planted near villages. Fls. Feb.-March. Fr. ripens in the following January when the tree is again bare of leaves, which it renews May-June.

Easily recognised by its mango like smell. Bark smooth white very thick and soft, blaze pink or light-red with narrow zones of lighter pink. Lflts. oblong acuminate with 10–30 horizontal sec. n. joined by a strong intramarginal one, petiolules short. Calyx salver-shaped with 5–6 ovate acute lobes. Petals ovate-oblong. Filaments short subulate. Carpels 4–6 free above united below into a 4–6-celled ovary, each lobe with a very short style. Drupe with a hard somewhat fibrous and slightly grooved 2–6-celled stone, usually 1–3-seeded, the other cells abortive.

It is not much used but the fruit is generally eaten as a condiment and made into chutney. Raw it is very astringent but occasionally palatable just as it ripens; it is greedily eaten by deer and other animals. "The pulp is useful in bilious dyspepsia and the leaves and bark in dysentery. The gum is demulcent" (*Nadkarni*).

THE

BOTANY OF BIHAR AND ORISSA

An Account of all the Known Indigenous Plants of the Province and of the Most Important or Most Commonly Cultivated Exotic Ones

With Map and Introduction

By

H. H. HAINES, C.I.E., F.C.H., F.L.S.

Late Conservator of Forests, Bihar and Orissa

Published under the Authority of the Government of Bihar and Orissa

PART III

CALYCIFLORÆ

LONDON

PRINTED BY ADLARD & SON & WEST NEWMAN, LTD.

And Sold by the Agents for Indian Official Publications

1922

Price Nine Rupees

Agents for the Sale of Books Published by the Bihar and Orissa Government.

Agents in India.

(1) Messrs. Thacker, Spink & Co., Calcutta.

(2) Messrs. W. Newman & Co., Calcutta.

(3) Messrs. K. S. Lahiri & Co., College Street, Calcutta.

(4) Messrs. R. Cambray & Co., 6 and 8-2, Hastings St., Calcutta.

(5) Messrs. Thompson & Co., Madras.

(6) Messrs. D. B. Taraporevala, Sons & Co., 103, Meadow Street Fort, Post Box No. 18, Bombay.

(7) Messrs. M. C. Sircar & Sons, Harrison Road, Calcutta.

(8) Proprietor of the Newal Kishore Press, Lucknow.

(9) Messrs. M. N. Burman & Co., Bankipore.

(10) Babu Ram Dayal Argarwala, 184, Katra Road, Allahabad.

(11) Standard Literature Co., Ltd., 13-1, Old Court House St., Calcutta.

(12) Manager of the Indian School Supply Depôt, 309, Bow Bazar Street, Calcutta.

(13) Messrs. Butterworth & Co., Ltd., 6, Hastings Street, Calcutta.

(14) Messrs. Ram Krishna & Sons, Anarkali Street, Lahore.

Agents in the United Kingdom.

(1) Messrs. A. Constable & Co., Ltd., 10, Orange St., Leicester Square, London, W.C. 2.

(2) Messrs. Kegan, Paul, Trench, Trübner & Co., 68-74, Carter Lane, London, E.C. 4, and (Oriental Department), 39, New Oxford Street, W.C. 1.

(3) B. Quaritch, Ltd., 11, Grafton Street, New Bond Street, London, W. 1.

(4) Messrs. P. S. King & Son, 2 and 4, Great Smith Street, Westminster, London, S.W. 1.

(5) B. Blackwell, Ltd., 50, 51, Broad Street, Oxford.

(6) Messrs. Deighton Bell & Co., Ltd., Trinity St., Cambridge.

(7) Messrs. Henry S. King & Co., 65, Cornhill, London, E.C. 3.

(8) Messrs. Grindlay & Co., 54, Parliament Street, London, S.W. 1.

(9) Messrs. W. Thacker & Co., 2, Creed Lane, Ludgate Hill, London, E.C. 4.

(10) Messrs. Luzac & Co., 46, Great Russell St., London, W.C. 1.

(11) Messrs. Oliver & Boyd, Tweeddale Court, Edinburgh.

(12) Messrs. E. Ponsonby, Ltd., 116, Grafton Street, Dublin.

(13) T. Fisher Unwin, Ltd., 1, Adelphi Terrace, London, W.C. 2.

(14) Messrs. Wheldon & Wesley, Ltd., 28, Essex St., London, W.C. 2.

Agents on the Continent.

(1) M. Ernest Leroux, 28, Rue Bonaparte, Paris, France.

(2) Martinus Nijhoff, The Hague, Holland.

(3) Messrs. R. Friedländer & Sohn, Carlstrasse 11, Berlin, N.W. 6, Germany.

(4) Otto Harrassowitz, Leipzig, Germany.

THE BOTANY OF BIHAR AND ORISSA

AN ACCOUNT OF ALL THE KNOWN INDIGENOUS PLANTS OF THE PROVINCE AND OF THE MOST IMPORTANT OR MOST COMMONLY CULTIVATED EXOTIC ONES

WITH MAP AND INTRODUCTION

BY

H. H. HAINES, C.I.E., F.C.H., F.L.S.

LATE CONSERVATOR OF FORESTS, BIHAR AND ORISSA

Published under the Authority of the Government of Bihar and Orissa

PART III

CALYCIFLORÆ

LONDON

PRINTED BY ADLARD & SON & WEST NEWMAN, LTD.

And Sold by the Agents for Indian Official Publications

(*For list see previous page*)

1922

Price Nine Rupees

FAM. 52. MORINGACEÆ.

Trees with alternate 2–3-pinnate deciduous leaves with small leaflets, stipules 0, but glands usually present at the base of the leaves and leaflets. Fls. m.s., zygomorphic, 2-sexual, white or red in many-fld. axillary panicles. Sepals, petals and stamens inserted on the margin of the disc which lines a cupular hypanthium, perigynous. Sepals petaloid reflexed narrow. Petals somewhat unequal, two upper erect, the others reflexed. Stamens in two whorls with somewhat unequal filaments, the episepalous ones more or less reduced to staminodes, anthers 1-celled, introrse. Ovary on a short gynophore, 1-celled, with 3 parietal placentæ and terminal style. Ovules numerous, 2-seriate on each placenta, pendulous anatropous with ventral raphe. Fruit pod-like, 3–6-angular and 3-valved, seeds along the centre line of each valve, separated by corky protuberances, 3-winged or wingless. Embryo straight with thick cotyledons, radicle superior, plumule with several leaf-rudiments, albumen 0.

1. MORINGA, *Juss.* (The only genus.)

1. **M. oleifera,** *Lamk.* Syn. M. pterygosperma, *Gaertn.* Munga ara, *M.*; Sojna, Sohajna, *H., Beng.*; Munagha, *Or.*; Horse-radish tree.

A small tree with elegant 3–4-pinnate leaves, pubescent or tomentose when young, and small elliptic or ovate leaflets ·2–·9″ long, pale beneath. Panicles tomentose, branches 6–9″ long. Fls. white, 1″. Capsules pendulous, 9–18″ long, seeds 3-gonous, winged.

Wild in the valleys of the Ramnagar Hills, along river beds! Cultivated in all districts. Fl. Jan.–March. Fr. April–June. Decid. Dec.–Feb. or new leaves in January.

Bark grey, corky. Young parts tomentose. Two upper petals yellow spotted, lower larger, ·75″ long, oblanceolate, the lateral strongly reflexed.

The leaves, flowers and fruit are eaten as vegetables, and the tree is usually pollarded for the purpose of fodder. The pungent root is used as a vesicant and has the odour and flavour of horse-radish, for which it is used as a substitute. Distilled with water the root yields a very pungent essential oil, but it is rarely used as such in Hindu medicine, either decoctions of the root or the expressed juice being preferred. The seeds yield a fine fixed oil (*Ben*) which is used by perfumers for extracting the odours of flowers and by watch-makers as a lubricant (*fide Nadkarni*).

The tree grows readily from cuttings.

FAM. 53. PAPILIONACEÆ (Leguminosæ).

Trees, shrubs or herbs with simple, 1-foliolate or compound leaves and strongly zygomorphic flowers. Calyx equally, or usually unequally lobed, often 2-lipped and usually somewhat perigynous, in a few cases developed into a distinct elongate hypanthium. Petals 5, imbricate, posterior (standard) exterior in bud, 2 lateral (wings) more or less declinate free or adhering to the keel, 2 lowest (anterior) usually more or less connate into one (keel) laterally compressed. Stamens 9 or 10 on the disc lining the very short or elongate hypanthium combined into an open or closed tube (monadelphous) or diadelphous (5 + 5 or 9 + 1), very rarely (*Sophora*) free, alternate ones

sometimes different. Ovary free, usually linear, 1-carpellary with simple style and stigma, usually with 2–many ovules on the ventral* suture, rarely sub-globose with only 1 ovule. Fruit (pod) usually follicular and 1-celled, sometimes indehiscent and sometimes septate and sometimes breaking up into one-seeded joints. Seeds albuminous or exalbuminous.

The germination of the Papilionaceæ is variable, from hypogeal to epigeal, but usually hypogeal with, however, the first leaves ***simple and opposite*** and thus simulating cotyledons. The shape of these is very different, from cordate and palminerved as in *Canavalia* and some ***Phaseolus*** to linear-lanceolate and penninerved as in *Cajanus*.

§ Stamens monadelphous or diadelphous (1–57):—
- † Stipellæ absent.† Mostly herbs or undershrubs. Pod usually dehiscent (cp. †††) (1 to 25):—
  - I. L. simple or digitately 3-foliolate (5-fol. in one species of Crotalaria). Leaflets entire, not gland-dotted (*Genisteæ*) (cp. 31. *Flemingia*):—
    - Fls. small solitary axillary. Pod compressed, 1–2-seeded . . . 1. *Heylandia.*
    - Fls. on 2–more-flowered peduncles. Pod turgid . . . . 2. *Crotalaria.*
  - II. Leaves pinnately 3-foliolate. Herbs with the sec. n. of lflts. excurrent as teeth. St. diadelphous (*Trifolieæ*).
    - *a.* Pod dehiscent, elongate . . . . 3. *Trigonella.*
    - *b.* Pod indehiscent.
      - Racemes slender. Pod sub-globose or very short. . 4. *Melilotus.*
      - Racemes not slender. Pod spiral or sickle-shaped . 5. *Medicago.*
  - III. L. simple, pinnately 3-many-foliolate with entire leaflets (rarely toothed and then st. diadelphous). Pod not jointed (*Galegeæ*):—
    - A. Anthers apiculate. Hairs fixed by centre (very few exceptions).
      - L. 3-foliolate, leaflets toothed . . . . 6. *Cyamopsis.*
      - L. 1-several-foliolate. Lflts. entire . . . . . 7. *Indigofera.*
    - B. Anthers not apiculate. Hairs basifixed.
      - 1. Leaves gland-dotted. Pod 1-seeded indehiscent . . 8. *Psoralea.*
      - 2. Leaves not gland-dotted. Pod several-seeded, dehiscent:—
        - *a.* Erect or diffuse herbs or shrubs. Pod soon dehiscing:—
          - Lflts. 5–25, usually odd. Pod flattened . . . 9. *Tephrosia.*
          - Lflts. 20–80, often even. Pod long slender septate. 10. *Sesbania.*
        - *b.* Climbing shrubs. Pod often woody and tardily dehiscent . . . . 11. *Millettia.*
  - IV. Leaves even-pinnate with the rhachis ending in a tendril or bristle. Pod dehiscent, not jointed (*Vicieæ*):—
    - A. Stamens 9. Slender climbing shrubs . . . . . 12. *Abrus.*
    - B. Stamens 9+1. Herbs (in our area):—
      - 1. Leaflets toothed. Style glabrous. Pod turgid . . 13. *Cicer.*
      - 2. Lflts. entire (exc. *Pisum*). Style usually hairy. Pod compressed (or turgid in the cultivated *Pea*):—
        - *a.* Staminal tube with oblique mouth:—
          - Ovules 3-many (or, if only 2, then beard annular) . 14. *Vicia.*
          - Ovules only 2. Style longitudinally bearded . . 15. *Lens.*
        - *b.* Staminal tube truncate:—
          - Style broad upwards but margins not recurved . 16. *Lathyrus.*
          - Style broad upwards with the margins recurved . 17. *Pisum.*
  - V. Leaves odd-pinnate (exc. *Zornia, Arachis, Smithia*), rarely only 1–3-foliolate. Pod jointed (joints 1-seeded, sometimes only 1–2). (*Hedysareæ*):—
    - 1. Stamens 9+1:—
      - L. 3-foliolate. Ovule and joint 1 only . . . . 18. *Lespedeza.*
      - L. 1-foliolate. Spiny shrub. Joints few . . . 19. *Alhagi.*

---

* The term ventral is here used in the strict botanical sense, but as the ovary is declinate the suture is uppermost, or dorsal in the ordinary sense of the word, and faces the vexillum or standard.

† Minute in some *Galegeæ*.

2. Stamens monadelphous with dimorphous anthers :—
   L. with 1-2 prs. of leaflets. Joints 2-6 . . . . . 20. *Zornia.*
   L. 3-foliolate. Calyx-tube very long. Joints 1-2 . 21. *Stylosanthes.*
   L. with 2 prs. of lflts. Calyx-tube very long . . 22. *Arachis.*
3. Stamens 5+5 :—
   a. Joints folded inside the calyx . . . . . . 23. *Smithia.*
   b. Joints several exserted :—
      Calyx with two entire or sub-entire lips . . . 24. *Æschynomene.*
      Calyx teeth distinct . . . . 25. *Ormocarpum.*

†† Stipellæ present (sometimes absent in Cajaneæ and then leaves gland-dotted) (26 to 53).

VI. (*Hedysareæ, continued.*) As above, but stipellæ present :—
   Stamens 9+1. (Joints inconspicuous in some *Pseudarthria* and *Desmodium*) :—
   1. Ovary 1-ovuled. L. 1-foliolate. Raceme very lax . 26. *Eleiotis.*
   2. Ovules several :—
      a. Pod twisted up so that the joints are transverse to its axis . . . . 27. *Uraria.*
      b. Pod not twisted up :—
         i. Pod turgid, often terete . . . . . . 28. *Alysicarpus.*
         ii. Pod flattened :—
            Deciduous tree. Joints 1-5 large . . . . 29. *Ougeinia.*
            Undershrub. Pod not septate, scarcely indented. *Pseudarthria* (see *Desmodium*, sec.).
            Shrubs or herbs. Pod usually septate and indented 30. *Desmodium.*

VII. Climbers, rarely erect or sub-erect with pinnately 3-foliolate (exc. *Flemingia*) leaves. Pod dehiscent, not jointed (*Phaseoleæ*) :—
   A. Leaves gland-dotted. Nodes of raceme not tumid (Sub-tribe *Cajaneæ*) :—
      1. Ovules 1-2. L. 1-3-foliolate :—
         a. Calyx not much accrescent :—
            Erect or prostrate undershrubs. L. digitate or 1-foliolate. Fls. white or red. Pod turgid (cp. Genisteæ) . . . . 31. *Flemingia.*
            Erect. Pod compressed . . . . 32. *Eriosema.*
            Erect or climbing. L. pinnately 3-fol. Pod turgid . 33. *Rhynchosia.*
         b. Calyx with very accrescent teeth. Climber . . 34. *Cylista.*
      2. Ovules 3 or more :—
         a. Pod without channels between the seeds . . . 35. *Dunbaria.*
         b. Pod channelled between the seeds :—
            Seed with a large grooved strophiole . . . . 36. *Atylosia.*
            Seed estrophiolate . . . . 37. *Cajanus.*
   B. Leaves not gland-dotted :—
      1. Nodes of raceme not tumid. Style beardless (Sub-tribe *Glycineæ*) :—
         a. Stamens diadelphous. Stipules and bracts persistent :—
            Style filiform. Calyx-teeth distinct . . . . 38. *Shuteria.*
            Style flattened upwards. Calyx truncate . . . 39. *Dumasia.*
         b. Stamens monadelphous. Stipules and bracts caducous :—
            Anthers all fertile . . . . 40. *Glycine.*
            Alternate anthers abortive . . . . . . 41. *Teramnus.*
      2. Nodes of raceme tumid. Style beardless :—
         a. Petals equal in length (Sub-tribe *Galactieæ*) :—
            i. Herbs. Stamens diadelphous :—
               Two upper calyx-teeth distinct . . . . 42. *Grona.*
               Two upper calyx-teeth connate into one . . 43. *Galactia.*
            ii. Stamens 1- rarely 2-adelphous. Suffruticose. Upper lip of calyx projecting . . . . 44. *Canavalia.*
            iii. Climbing shrubs. Upper lip of calyx not projecting :—
               St. diadelphous. Pod 1-seeded (inc. *Spatholobus*). 45. *Butea.*
               St. monadelphous. Pod linear many-seeded . 46. *Pueraria.*
         b. Petals very unequal (Sub-tribe *Erythrineæ*) :—
            Climbers. Keel exceeding wings and standard . 47. *Mucuna.*
            Trees or undershrub. Standard exceeding keel . 48. *Erythrina.*
      3. Nodes of raceme usually tumid. Style bearded (Sub-tribe *Euphaseoleæ*) :—

a. Stigma oblique :—
Keel spirally beaked . . . . 49. *Phaseolus*.
Keel incurved. Style not flattened . . . . 50. *Vigna*.
Keel not spiral. Style flattened upwards and circinate 51. *Pachyrhizus*.
b. Stigma terminal, not oblique :—
Petals equal . . . . 52. *Dolichos*.
Petals unequal. Flowers large, blue . . . . 53. *Clitoria*.
††† Stipellæ rarely present. Woody plants. Pod indehiscent :—
VIII. Leaves pinnate. Pod flattened (*Dalbergieæ*) :—
1. Leaflets alternate :—
Flowers small, white or pink . . . . . . 54. *Dalbergia*.
Flowers m.s., yellow . . . . 55. *Pterocarpus*.
2. Leaflets opposite :—
Pod rather thin and usually winged . . . . 56. *Derris*.
Pod rather thick and woody, not winged . . . 57. *Pongamia*.
§§ Stamens free :—
IX. Leaves odd-pinnate. Pod not jointed, moniliform. Erect shrubs (*Sophoreæ*) . . . . 58. *Sophora*.

1. HEYLANDIA, *DC*.

A single species with simple entire sub-sessile leaves, small flowers solitary in the axils, keel of corolla beaked, stamens monadelphous, ovary sessile 2-ovuled, pod short oblong flattened 1–2-seeded.

1. H. latebrosa, *DC*.

A prostrate herb with many dichotomously-branched slender stems 8–18″ long and close-set alternate spreading obliquely ovate leaves thinly villous. Flowers solitary subsessile ·25″ long, yellow or white with purple veins. Pod silky beaked ·2–·25″.

Dry grassy places, not common. Fl., Fr. Sept.–Oct.

2. CROTALARIA, *L*.

Herbs or low shrubs or undershrubs with simple or 3-foliolate, very rarely 5-foliolate, stipulate or exstipulate, often pellucid punctate, entire leaves. Fls. racemose, sometimes also axillary, small or showy. Calyx teeth usually narrow, upper sometimes broader and connate. Corolla exserted or not, standard usually broad shortly clawed, keel petals connate into a conspicuously incurved beak. St. monadelphous, anthers dimorphous. Ovary linear, rarely only 2- usually many-ovuled ; style long abruptly incurved with the keel, bearded upwards with minute oblique stigma. Pod very turgid without septa, seeds usually nearly as many as the ovules.

The distinction of terminal and leaf-opposed racemes is only relative ; normally terminal racemes become leaf-opposed owing to the stronger growth of the axillary shoots.

I. Leaves simple. Mostly herbs under 3 ft. Corolla rarely (no. 6) exserted :—
A. Racemes becoming leaf-opposed (exc. sometimes 3), few-fld.
1. Stipules 0. Fls. under 6 in a raceme :—
a. Pod sub-globose. Peduncles slender . . . . 1. *biflora*.
b. Pod oblong :—
L. with long spreading hairs, base cordate . . 2. *trichophora*.
L. only silky, base not cordate, oblong, ·7–1·5″ . 3. *prostrata*.
As in (3), but L. linear-oblong, ·25–·5″ . . . var. *levis*.

2. Stipules present, branches not winged :—
   L. broadly elliptic, ·15–1″. Fls. ·25″ . . . . 4. *acicularis.*
   L. ovate-lanc. or ovate oblong, 1–2″. Fls. ·5″. Pod glabrous . . . . 5. *ferruginea.*
   L. ovate, 1–2·5″. Pods hairy . . . . 6. *hirsuta.*
3. Stipules spreading and decurrent as large persistent wings on the branches . . . . . . 7. *alata.*

B. Racemes not becoming leaf-opposed :—
1. Racemes very short. Stipules 0 :—
   L. ·2–·7″. Racemes ·5–1″ long. Fls. ·1–·12″. . . . 8. *pusilla.*
   L. ·5–·75″. Racemes capitate. Fls. ·25″ . . . 9. *hirta.*
2. Racemes 6–9-fld., elongate. Stipules foliaceous . . 10. *mysorensis.*
3. Racemes elongate, usually many-fld. L. under 2″ long. Stipules 0 :—
   Upper calyx-lobes connate high up. Pod not exserted . . . . 11. *linifolia.*
   Calyx lobes nearly free. Pod much exserted . . 12. *albida.*
4. Racemes elongate. L. 2–6″ long. Stipules minute :—
   Calyx ·75–1″. Fls. yellow . . . . . . 13. *calycina.*
   Calyx ·3–·5″. Fls. blue . . . . . . 14. *sessiliflora.*

II. Leaves simple. Herbs over 4 ft. high, or undershrubs. Corolla little or much exserted :—
A. Bushy much branched undershrubs :—
   L. rather broad, often rhomboid. Fls. blue and yellowish 15. *verrucosa.*
   L. very short linear. Inflorescence glandular . . . 16. *ramosissima.*
B. Tall usually strict herbs or shrubs : —
1. Herbaceous glabrous. Corolla much exserted. Pod glabrous . . . . 17. *sericea.*
2. Sub-woody silky. Cor. slightly exserted. Pod velvety :—
   L. 2–4·5″ linear or oblong . . . . . . 18. *juncea.*
   L. 6–12″ linear-lanceolate acuminate . . . . 19. *tetragona.*

III. Leaves trifoliolate :—
   Suffruticose 3–5 ft. Lflts. 2–3″ . . . . 20. *striata.*
   Herbaceous, often diffuse : —
   Lflts. 1–1·3″. Pod ·5″ oblong . . . . 21. *orixensis.*
   Lflts. ·2–·7″. Pod sub-globose . . . . 22. *medicaginea.*

IV. Leaves mostly 5-foliolate :—
   Lflts. linear-oblong or -oblanceolate . . . . . 23. *quinquefolia.*

1. **C. biflora,** *L.*

A silky trailing herb with sometimes very numerous branches from 8–12″ long from a woody root, small sessile oblique broadly ovate or sub-orbicular leaves ·25–·75″ long, small flowers usually 2 together on long slender peduncles and comparatively large sub-globose pods.

Behar, *Kurz* !

2. **C. trichophora,** *Baker.*

A slender much branched diffuse herb covered with very long spreading slender villi, sometimes ·25″ long. Leaves ·75–1·3″ sessile with oblique sub-cordate base. Fls. very small, ·15″ on filiform 1–2-fld. leaf-opposed peduncles. Pods ·3″.

Behar, rare, *Kurz* !

3. **C. prostrata,** *Roxb.* Nanha jhunka, Katic jhunka, *S.*

A silky herb with spreading or long trailing slender branches from a perennial root, close oblong or ovate-oblong obtuse leaves ·5–1·5″ long, glaucous beneath and densely silky, base oblique rounded but not cordate. Racemes on slender peduncles 2–4-fld. soon leaf-opposed attaining 3″. Pod ·5–·7″, glabrous, shortly stipitate, 16–20-seeded.

Very common on clay in open Sal forest, etc. Champaran! Chota Nagpur, all districts! Probably throughout the province. Fl., Fr. Sept.-Dec.

Stipules 0. Fls. ·2-·27″, three lower calyx lobes linear acuminate shorter than the twisted keel, upper longer linear oblong connate half to three-fourths way up as long as standard.

Var. **levis,** *Haines.*

A small herb with numerous branches from a woody rootstock, small linear to oblong simple exstipulate strigosely-hairy leaves ·25-·5″ long and slender terminal (leaf-opposed) racemes of 4-7 yellow flowers ·22-·25″ long, the corolla only as long as the calyx or very slightly exserted. Pod as in type.

Neterhat 3000 ft. in open places. Fl., Fr. May-Dec.

Branches strigose. L. opaque. Petioles minute. Racemes 1-4″, exceeding the branches, somewhat wavy. Bracts minute setaceous. Pedicels ·1-·2″ slender. Calyx strigose ·2″, upper teeth lanceolate acute sinus ·06″, lower teeth rather narrower with sinus ·1″ deep between them. Standard very slightly exserted emarginate ·18″ broad with 2 small callosities at base.

Distrib. from United Provinces to the Shan Hills usually in the hills. May be distinguished from small specimens of *C. albida* in the absence of fruit by the opaque leaves.

4. **C. acicularis,** *Ham.*

A small procumbent much branched very hairy weed with a woody rootstock when old. Branches 4-10″. L. broadly elliptic ·15-·75″ scarcely petioled, base oblique rounded. Racemes 1-2″, 2-several-flowered, fls. ·25″. Pod small black ·25-·3″ oblong.

Open grassy places, often very conspicuous on cold mornings from the dew adhering to the hairs and giving it a grey or silvery look. Frequent. Chota Nagpur! Sambalpur! Fl., Fr. Nov.-Jan.

5. **C. ferruginea,** *Grah.*

Stems ascending 2-3 ft. branched more densely hairy, leaves oblong-ovate to oblong 1·5-1·75″, stipules lanceolate, racemes pubescent lax 1-6-fld.; flowers ·4-·5″ long, calyx with teeth as long as corolla.

Chota Nagpur, elev. 2000 ft.-3000 ft.! Fl., Fr. Sept.-Nov.

Leaves pubescent rounded both ends. Stipules conspicuous spreading ·2-·25″. Racemes axillary and terminal, 2-5″ long. Bracts ·2″. Bracteoles linear. Calyx 2-lipped often reddish, lower lobes oblong-lanceolate linear, standard with purplish veins. Pod ·7-·9″ nearly glabrous, ·3″ broad, seeds about 25.

6. **C. hirsuta,** *Willd.*

An erect hairy herb 2-3 ft. high with broadly ovate simple leaves 2-2·3″ long, very narrow stipules and terminal few-flowered racemes of yellow flowers ·5″ long with very long lanceolate calyx-teeth nearly as long as corolla.

Rather common in rocky jungles. Chota Nagpur! Fl., Fr. Aug.-Oct.

Hairs soft spreading. L. thin, with rounded base, mucronulate. Petiole hardly any. Stipules acicular-subulate spreading and reflexed ·1-·14″. Racemes ultimately leaf-opposed, usually under 2″. Standard spotted brown. Pod ·75-1″ with spreading hairs, about 6-10-seeded.

7. **C. alata,** *Ham.* Marang jhunka, *S.*

Stems 1-3 ft. branched sub-erect softly hairy, winged. Leaves subsessile elliptic oblong or obovate 1-2·7″, usually oblique-based,

finely shortly silky beneath, scarely punctulate. Petiole ·15″. Stipules decurrent. Racemes terminal and ultimately leaf-opposed. Racemes 3-4″, few-flowered, with small petioled lanceo. bracts. Fls. ·5-·6″, calyx as long as corolla. Pod oblong 1·25-1·5″ narrowed at base into a stalk, far exserted.

Frequent. Hills of Ramnagar! Chota Nagpur! Sambalpur!
Fl. Aug.-Nov. Fr. Sept.-Dec.

8. **C. pusilla,** *Heyne.*

A small plant 3-5″ high with numerous usually spreading branches from the root and densely covered throughout with brown villous hairs. Leaves linear subsessile ·25-·75″. Sepals linear subulate ·08″ brown villous. Pod ·2″, the long brown hairs leaving small dots when rubbed off.

Bihar, *Kurz*! Fl., Fr. Sept.-Jan.

9. **C. hirta,** *Willd.*

A herb, scarcely sub-fruticose, somewhat resembling narrow-leaved forms of *C. mysorensis* but is a smaller plant in all its parts and more diffuse. Branches densely clothed with short patent brown hairs. L. linear or linear-oblong without stipules, hairy. Fls. only 2-4 subcapitate with lanceolate foliaceous bracts. Calyx ·25″ with teeth all linear acuminate. Pod oblong ·5″.

Not common. Behar, *Kurz*! Savannahs, Singbhum, 2000 ft.! Fl. March.

10. **C. mysorensis,** *Roth.*

A rather strict herb 3-4 ft. high covered with long spreading or erecto-patent hairs. Leaves sessile linear to oblong mostly about 2″ long with erect foliaceous persistent stipules ·3-·6″ long. Flowers sub-solitary or in few-fld. terminal racemes with lanceolate bracts ·5-·6″ long. Pod exserted 1-1·25″ shortly stipitate in the deeply cut very hairy calyx.

Frequent in Chota Nagpur and the Santal Parganas! Fl. Aug.-Oct. Fr. Nov.-Jan.

The stipules which sometimes look like subsidiary leaves and in some Koderma plants are as large, are very characteristic. L. 2-3″ pellucid-punctate. Lower sepals linear acuminate ·5-·75″ villous with brown hairs. Seeds 40-50 small black shining sharply hooked.

11. **C. linifolia,** *L.*

A herb 1-2 ft. high erect or with ascending branches, somewhat resembling the last in leaf but with black globose or oblong-ovoid pods only as long as the calyx and the marcescent corolla drying black.

Less common and more often in the open. Ranchi! Hazaribagh, *Wood*! Singbhum, *Clarke*! Fls. Sept.-Oct. Fr. Oct.-Nov.

Stems somewhat strigosely hairy. Leaves usually oblanceolate, sometimes linear but slightly wider upwards, 1-1·75″, appressed silky beneath and with pellucid dashes. Racemes 3-6″. Fls. ·25″, calyx hirsute, upper lip not deeply lobed, pod punctate, glabrous.

12. **C. albida,** *Heyne.*

A herb or undershrub with stems very many up to 3 ft. high from a woody rootstock, sparingly branched with fastigiate appressed-

hairy or silky branches, narrow leaves and yellow flowers ·3-·5″ with a very shortly exserted corolla in terminal racemes with few or up to 25 flowers.

One of the commonest forest Crotalarias, very abundant on hard clay soil on hilly ground throughout Chota Nagpur! Angul! Probably occurring in all districts. Fls., Fr. Sept.-Jan.

Stems appressed pubescent above. L. linear-oblong, oblong or oblanceolate ·8-3″ by ·25-·6″ obtuse or rounded mucronate pubescent or laxly hairy above, glaucous and silky beneath, base narrowed to a very short petiole, copiously pellucid punctulate. Stipules 0 or minute subulate. Calyx very silky, two upper lobes oblong obtuse. Pod glabrous ·5″, slightly exserted, 6-8-seeded on pedicels ·25″ long.

13. **C. calycina,** *Schrank.* Mota bir-jhunka, *S.*

Herbaceous 1-3 ft. high with appressed brown-hairy branches and long lanceolate or linear leaves 3-5″. Easily recognised by the pale-yellow corolla being shorter than the very large ·75-1″ long calyx which is shaggy with long brown hairs.

Frequent. Singbhum! Palamau! Hazaribagh! Santal P.! Probably in all districts. Fls. r.s. Fr. Oct.-Nov.

L. appressed brown-hairy beneath, very acute, closely pellucid-punctulate. Fls. axillary in the upper leaves and in terminal racemes with persistent linear-lanceolate bracts. Pod included, glabrous. Seeds pale yellow or white.

14. **C. sessiliflora,** *L.*

Will probably be found in Purneah as I have found it quite close to that district in Bengal. It is very like *C. calycina* but can be easily recognised by the blue corolla. Wet places. Fl. Sept.

15. **C. verrucosa,** *L.*

A much branched erect undershrub 3-4 ft. high with 4-ridged or -winged shortly silky branches, broadly rhomboid leaves and terminal leaf-opposed 3-7-fld. racemes 1·5-3″ long of blue and yellowish flowers. Pod subsessile 1″ thinly silky.

Mals of Orissa! Fl. March-May. Fr. April-May.

L. only 1-2″ in plants seen by me, 4-6″ according to *F.B.I.*, obtuse, retuse or rounded, sometimes shallowly lobed wavy or crenate, glaucous, shortly silky both sides. Petiole short. Stipules large broad auriculate ·2-·4″ shortly cuspidate, attached by a narrow base. Calyx ·4″. Standard ·5″ blue-veined, wings ·5″ long blue-veined and deep blue apically, keel pale ·5″. Bracts subulate ·07″. Seeds 12 or more.

16. **C. ramosissima,** *Roxb.* Harduli, *Gond.*

A densely branched small shrub 1·5-2 ft. high and as broad, stems, leaves and inflorescence densely silkily hirsute. Leaves ·5-1″ long linear. Flowers yellow tinged with red in very numerous few-flowered short racemes terminating all the branchlets. Pods ·3″ long, 1-seeded.

Quartzite rocks in open forest. Sambalpur! Fl. Oct.-Dec.

Usually grey or fulvous from the numerous hairs. L. with recurved margins, obtuse. Bracts and bracteoles ovate and with the calyx covered with a very viscid secretion which stains clothes brown and becomes a pest.

17. **C. sericea,** *Retz.* Sakesing, *K.*; Junka, *Or.*

A tall handsome bright green herb 3-5 ft. high with often hexagonal waxy stems, oblanceolate to obovate leaves 3-6″ long with persistent stipules and long terminal often panicled racemes of

bright yellow flowers over 1″ long with persistent spreading or reflexed lanceolate or ovate acuminate foliaceous bracts ·3–·5″. Pod glabrous 1·5″.

Frequent in grass under light shade and along streams. Throughout the province, but rarely outside the forest tracts! Fls. Sept.–Feb. Fr. Dec.–May. Biennial.

L. finely appressed silky beneath, sub-acute or obtuse, petiole short and stout, stipules variable in size. Racemes 8–12″. Calyx ·75″.

18. **C. juncea,** *L.* Jiri, *M.* (jiri-bair, the fibre); Ji, *Ho.*; Son, *S.*; San, *H.*; Sun Hemp.

A strict shrub 4–6 ft. high with virgate grooved stems and branches and linear or linear-oblong leaves 2–4·5″ long. Flowers 1″ long, yellow in lax lateral and terminal racemes 6–12″ long. Beaked sepals, pedicels and pods all softly closely pubescent or velvety. Corolla slightly exserted, standard 1″ broad and long, veined red, silky without. Pod 1–1·4″.

Apparently wild along streams in the Northern Champaran forests! Cultivated and sometimes apparently wild in Singbhum and the Ranchi scarps! Cultivated in most districts. Fl. Aug.–Jan. Fr. Dec.–Feb.

Yields the fibre known as Sun Hemp.

19. **C. tetragona,** *Roxb.*

A much stouter shrub than the last with angular pubescent branches, narrowly lanceolate very acute or acuminate leaves 6–12″ long and lateral and terminal racemes of large lemon-yellow flowers with glabrous slightly exserted corolla. Pod 1·5–2″ stout densely brown-velvety.

Grassy ravines, N. Champaran, rare! Probably also Purneah. Fl. July–Oct. Fr. Oct.–Jan.

20. **C. striata,** *DC.* Sakesing, *K.*; Son-jhunka, *S.*; Junjunka, *Or.*

An undershrub 3–5 ft. high with slender branches, long-petioled trifoliolate leaves and terminal and lateral elongate racemes 6–12″ long. Fls. yellow ·75″ long, usually streaked with purple. Pods 1·5–2″ by ·25″, 30–40-seeded, silky when young and more or less glabrescent.

Waste ground and along road-sides, throughout the province, locally abundant and sometimes cultivated for its fibre. Common in Orissa and the Mahanadi delta! Annual. Fl., Fr. Oct.–April.

Lflts. 1–2·5″ broadly elliptic or obovate, with sparse appressed hairs beneath, base cuneate, tip rounded. Petiole 1–2″.

Possibly an introduced plant. It is now very common near Calcutta and it is curious that *Roxburgh* makes no mention of it. *Prain* distinguishes between *C. Saltiana*, And. (our species), with obtuse obovate leaflets and *C. Brownei*, Bert., with oblong acute leaflets, which latter he says is cultivated and in some places naturalised in Bengal.

21. **C. orixensis,** *Roxb.*

Stems several diffuse from a perennial root, lflts. elliptic or obovate, 1–1·3″ long. Racemes erect very long and slender with ovate lanceolate bracts ·2″ and yellow flowers ·25–26″ on slender pedicels ·3–·4″ long. Pods very turgid ·4″ long with a long stipes.

Open waste ground and borders of fields. Behar, *Kurz*! Orissa, *Prain*. Fl., Fr. Aug.–Oct.

Branches and leaves beneath thinly hairy or strigose, lflts. sessile.

22. **C. medicaginea,** *Lamk.*

A diffuse herb or with slender erect branches 1 foot high with 3-foliolate leaves, linear-oblong or -oblanceolate leaflets ·4–·7″ with petioles shorter than the terminal leaflet, small yellow fls. axillary and in terminal racemes and leaf-opposed racemes 1–2″ long. Pod small obliquely-globose ·12″ diam. grooved and shortly beaked, thickly or thinly pubescent with 2 shining brown seeds.

Champaran! Palamau! Fl. r.s. Fr. Oct.–Nov.

Branches with appressed and spreading pubescence. Petioles up to ·5″. Lflts. rounded or emarginate at tip, silky beneath. Terminal racemes 2–15-fld. Calyx ·1″, upper teeth widely separate. Corolla ·2″ with very acute beak.

The more robust erect forms with many-fld. terminal racemes constitute the var. *luxurians* of the *F.B.I.*, and the small prostrate forms with very few fls. the var. *herniarioides.*

23. **C. quinquefolia,** *L.*

An erect annual 2–4 ft. high with sulcate thinly silky branches, usually 5, rarely 3, linear or narrowly oblanceolate leaflets 2–4″ long, silky beneath, and terminal racemes up to 6″ long of rather large yellow flowers ·5″ long with linear-lanceolate reflexed bracts. Pod oblong glabrous 1·5–2″ or 2·5″ long and ·75–1″ broad, pedicelled.

Rare in our area. Bihar, in wet places! Bihar and Chota Nagpur (teste *Bengal Plants*). Fls., Fr. Nov.–Feb.

3. TRIGONELLA, *L.*

Herbs with pinnately 3-fol. leaves and adnate stipules. Fls. axillary or in axillary racemes, sometimes capitate, bracts minute or 0. Calyx teeth subequal. Stamens usually diadelphous or posterior filament sometimes connate to the middle, anthers uniform. Ovary many-ovuled. Pod often indehiscent, elongated, straight or falcate, sometimes beaked, not septate, many-seeded.

Erect. Fls. axillary. Pod beaked . . . . 1. *fœnum-græcum.*
Diffuse. Fls. racemose. Pod not beaked . . . . . 2. *corniculata.*

1. **T. fœnum-græcum,** *L.* Methi, *Beng, H.*; Fenugreek.

An erect strong-smelling herb 1–2 ft. with thinly hairy or subglabrous stems and oblong-oblanceolate denticulate obtuse or rounded leaflets ·5–1·25″ long. Petiole ·3–·5″. Fls. pale sessile 1–2 together in the axils of the young leaves. Pods at first straight, often falcate with age, 3–4″ by ·2″ with a long fine beak.

Cultivated in the gardens of Indians! Purneah, *Ham.*! Fl., Fr. Jan.–March.

The young plants are used as vegetables and the seeds in curries. The seeds are mucilaginous and various properties are ascribed to them; among others they are said to prevent baldness.

2. **T. corniculata,** *L.* Piring, *Beng.*

A diffuse herb with branches about 10″ long, lflts. obovate ·3–·75″ denticulate, petiole slender ·25–·5″. Peduncles filiform ·5–1″ with several flowers ·15–·25″, peduncles ending in a sharp point or awn. Pods ·25–·75″ slightly curved, not beaked.

Rare. Bihar, *Kurz*! Cultivated in Tirhut, *Prain.*

4. MELILOTUS, Juss.

Herbs with toothed pinnately 3-foliolate leaflets and small flowers in long slender racemes. Standard and wings narrow, keel straight obtuse. St. diadelphous, anthers uniform. Ovary few-ovuled, style much incurved glabrous. Pod oblong exserted, indehiscent.

1. **M. indica,** *All.* Syn. M. parviflora, *Desf.*; Trifolium indicum, *L.*

A slender herb 1–1·5 ft. Lflts. obovate or oblanceolate ·5″ long glabrous. Fls. very small, ·1″ long, white in spiciform racemes 1·6–2·2″ long. Pod scarcely longer than the calyx when 1-seeded, sometimes 2-seeded.

Chota Nagpur, Hazaribagh, *Clarke*! Fl., Fr. c.s.

2. **M. alba,** *Lamk.* Syn. M. vulgaris, *Willd.*

Herb 1–2 ft. high much more robust than the last, lflts. ·1″. Flowers white ·2″ in racemes 3–4″ long or 4–6″ in fruit. Pods ·12″.

Not uncommon in cultivated lands in the north. In fields of dhal, *Prain*! In lucern crops, *Ranchi*! Fl., Fr. Jan.–April.

5. MEDICAGO, *L.*

Herbs with pinnately 3-foliolate leaves and toothed leaflets. Corolla more or less exserted, standard and wings oblong, keel straight obtuse. St. diadelphous, anthers uniform. Ovary usually many-ovuled, style short, little incurved, stigma oblique. Pod usually spirally twisted, sometimes sickle-shaped or reniform with spiral tip, rarely only 1-seeded (*lupulina*).

A. Sub-erect perennials. Fls. racemose, purple. Pod unarmed. Cultivated lucern . . . . 1. *sativa.*
B. Diffuse annuals. Racemes very short or sub-capitate :—
Pod reniform, unarmed, 1-seeded . . . . 2. *lupulina.*
Pod spiral, muricate, 2-more-seeded . . . . . . 3. *denticulata.*

1. **M. sativa,** *L.* Lucern, Alfalfa.

Stems slightly hairy 1–2 ft. high, lflts. narrow oblong with cuneate base to obovate-oblanceolate ·5–1·25″ with sharp teeth. Racemes stout 1·5–2·5″ including the peduncle. Pod silky forming a complete loop or a double spiral, venose, no intramarginal nerve parallel to the suture.

Frequently cultivated by Europeans as fodder for horses. It may be repeatedly cut before flowering. In the damper districts it is apt to be attacked by fungus in the rains and is best grown as an annual.

2. **M. lupulina,** *L.* Black Medick.

A small procumbent branched herb with pubescent branches 3–6″ long. Lflts small obovate or cuneate-obcordate, ·18–·35″; young very silky beneath, toothed, the sinus usually apiculate with a small triangular tooth. Fls. very small pale yellow in dense ovoid heads, oblong in fruit, on slender hairy peduncles much exceeding the petioles. Pod very small sub-globose reniform* with tip coiled,

* *Baker* (*F.B.I.*) describes the pod as minute linear sickle-shaped, which is, I think, a mistake. The Black Medick is found as far west as England, and my Indian specimens, though smaller, agree with the English ones.

1-seeded, with several strong raised concentric nerves and cross nervules, otherwise smooth, finally black.

Champaran, Bettiah, in fields! Fl., Fr. March.

3. **M. denticulata,** *Willd.* (*sensu F.B.I.*).* Toothed Medick.

A nearly glabrous herb with prostrate branches about 1 ft. long. Lflts. obovate or obcuneate, sometimes retuse at the apex, ·5″ long, petiole slender, 1″, stipules laciniate. Flowers very few, 2–5 only, umbelled, yellow, on a peduncle much shorter than the petioles. Calyx ·1″, teeth as long as tube. Pod ·12–·2″ diam. sub globose-spiral, muricate with strong nerves running parallel to margin, face reticulate, nervules meeting in intra-marginal one and with a nervule from each spine joining margin and the intra-marginal nerve.

Bihar, *Kurz*!
This species is also found in England, but is rare.

6. CYAMOPSIS, *DC.*

Erect herbs with laterally attached hairs as in *Indigofera* and pinnately 3-foliolate leaves with toothed leaflets. Stipules small. Stipellæ 0. Flowers in axillary close racemes with caducous bracts. Sepals connate into an oblique tube. Keel obtuse inappendiculate. Stamens 10 monadelphous with uniform anthers, connective apiculate. Ovary many-ovuled, stigma terminal capitate. Pod linear, subquadrangular, acuminate, septate. Seeds quadrate, compressed.

1. **C. tetragonoloba,** *Taub.* Syn. C. psoralioides, *DC.*; Guar, *H.*; Buru hahar, *S.*; The Cluster-bean.

Rather stout 2–3 ft. high with adpressed grey hairs. Lflts. 2–3″ ovate acute inciso-dentate. Racemes short-peduncled, close. Fls. pinkish ·2″. Pods clustered thick fleshy, 1·5–2·5″ long, 8–12 seeded.

Cultivated occasionally in Santal Parganas and Manbhum!
The young pods are eaten.

7. INDIGOFERA, *L.* Indigo.

Herbs or shrubs more or less clothed with hairs which in most cases are forked, each fork appressed. Flowers in short or long axillary racemes, sometimes sub-capitate, usually reddish. Calyx small or minute, campanulate, teeth 5 sub-equal or lowest longest. Standard usually broad; keel straight, not beaked, each petal spurred near the base. St. diadelphous, alt. filaments sometimes longer and narrower, anthers uniform, apiculate. Ovary sessile, style short incurved, stigma capitate usually pencillate. Pod usually linear or oblong, sometimes curved, in one species muricate.

I. Leaves simple. Herbs, usually small and prostrate:—
  1. Fls. clustered. Pod muricate, 1-seeded . . . . . 1. *echinata.*
  2. Pod unarmed:—
    L. linear. Pod globose, 1-seeded . . . . . . 2. *linifolia.*
    L. ovate cordate. Pod oblong, 2-seeded . . . . 3. *cordifolia.*

* Our species is probably var. *apiculata*, but *M. apiculata*, *Willd.* (=*M. denticulata*, *Willd.*, var.) does not agree with Gaertner's figure of *M. hispida* (Gaertner de fructibus et seminibus plantarum, 1788–91) to which it has been reduced by *Urban*, and I have not in this matter been able to follow that authority on Medicago.

II. Leaves 3-foliolate. Herbs:—
  1. Lflts. gland-dotted beneath. Pod short oblong . . . . 4. *glandulosa.*
  2. Lflts. not gland-dotted. Pods linear, narrow:—
    Racemes capitate sessile. Pods ·3–·5″ . . . . . 5. *trifoliata.*
    Racemes elongate. Pods ·7–·9″ . . . . 6. *trita.*
III. L. pinnate, or few only 3-foliolate:—
  A. Flowers small, under ·25″:—
    1. Lflts. alternate.
      Racemes sessile capitate. Lflts. 5–7 . . . . . . 7. *enneaphylla.*
      Racemes 1–4″ long. Lflts. 5–9 . . . . 8. *endecaphylla.*
    2. Leaflets opposite. Fls. only 2–4, ped. slender . . . 9. *pentaphylla.*
    3. Lflts. opposite. Racemes elongate:—
      a. Herbaceous, whole plant hirsute . . . . . 10. *hirsuta.*
      b. Shrubs. Hairs sparse appressed. (Dye Indigoes):—
      * Pods slender glabrescent, over 6-seeded.
      Lflts. 7–8 prs. Racemes 1·5–2·5″ . . . . 11. *arrecta.*
      Lflts. 3–6 prs. broad. Racemes 2–4″. Pod acute . . 12. *tinctoria.*
      Lflts. 3–6 prs. narrow. Pod stouter obtuse . . . . 13. *sumatrana.*
      ** Pods sausage-shaped, under 5-seeded, sericeous . . 14. *articulata.*
  B. Flowers large, over ·4″ long.
      Shrub. Lflts. 6–15 prs., ·5–1·5″. Sepals acuminate . . 15. *pulchella.*
      Undershrub. Lflts. 2–6 prs., ·5–·6″. Sep. acute . . 16. *Hamiltonii.*

1. **I. echinata,** *Willd.*

A herb with many branches from the root 6–12″ long with simple obovate leaves or orbicular-obovate leaves ·5–·75″ long and small flowers in very short axillary racemes ·7–1·5″ long including the peduncle. Calyx somewhat hispidly hairy with long teeth. Pods ·2–·25″ densely echinate on the two keels of the dorsal suture and somewhat hairy.

Ranchi, *Clarke*! Behar, *Kurz*!

2. **I. linifolia,** *Retz.*

A herb with prostrate two-edged or sub-4-angular grey pubescent slender stems 12–18″ long and linear or linear-oblong apiculate leaves ·3–1·2″ long, strigulose both sides. Fls. small bright red in axillary bracteate racemes ·15–1·1″ long. Pods sub-globose silvery-silky ·06″ only.

Very common on banks and in grassy places in the open, chiefly in the dryer districts! Fls., Fr. Aug.–Jan.

L. subsessile. Stipules filiform. Bracts linear subulate, deciduous or persistent. Calyx tube very short with subulate setaceous teeth as long as the pod.

The roots are usually copiously covered with tubercles, so that the plant is probably useful as a soil fertiliser.

3. **I. cordifolia,** *Heyne.*

A small herb with many spreading rather wiry branches from the root, hoary with a dense white pubescence, leaves very small, only ·2″ (in my specimens), but attain ·7″, ovate cordate obtuse or acute subsessile. Fls. minute bright red clustered 4–8 together. Calyx densely hairy. Pod. ·2″ pubescent 2- rarely 1-seeded.

On overgrazed pastures. Gaya! Fl., Fr. Sept.–Dec.

Some states superficially resemble *Heylandia.*

4. **I. glandulosa,** *Willd.*

Erect 1·5–2 ft. high, branched. Branches pubescent. L. 3-foliolate with petioles ·3–·5″ long and sub-digitate oblanceolate leaflets ·5–1″ long conspicuously gland dotted beneath and somewhat pubescent.

Fls. in dense clusters shorter than the petiole, corolla ·18″ long much exserted from the pubescent calyx. Pods short oblong ·2″ turgid hairy and with four lines of fibrillæ.

In the western dryer districts. Behar, *Kurz*! Fl. Aug.-Sept. Fr. Sept.-Nov.

5. **I. trifoliata,** *L.*

A copiously branched weed with spreading branches 6–12″ long thinly clothed with appressed bifurcate hairs. L. small with petioles shorter or equalling the 3 digitate oblong to oblanceolate ·25–1″ long strigosely hairy leaflets. Fls. in sessile very numerous capitate racemes shorter than the petioles, in fruit conspicuous by the numerous clusters of slender ·3–·5″ long 4–8-seeded pods.

Waste ground in Chota Nagpur, chiefly on the plateaux, frequent on firelines near Neterhat! Fl. r.s., Fr. Sept.-Oct.

6. **I. trita,** *L. f.*

Erect suffruticose slender 2–3 ft. with membranous 3-foliolate leaves, petiole ·5–·75″, leaflets variable in size, ·5–1·5″, the lateral much smaller than the terminal, obovate or ell.-obovate, with rather dense appressed short hairs both sides. Fls. dark red, at first close in racemes shorter than or much exceeding the leaves, short, then elongating to 1·3″, 6–12 fld. Calyx white canescent. Pods somewhat reflexed ·7–·9″ angular, hoary with appressed hairs, finely beaked, 6–10-seeded.

Not very common but wide-spread. Shahabad! Angul, *Lace*! Fl., Fr. all the year round.

7. **I. enneaphyla,** *L.*

A herb, sometimes sub-woody at base, with numerous stems 8″–2 ft. long and small pinnate subsessile leaves ·4–1·5″ long with mostly 5–7 alternate (rarely up to 11) linear oblanceolate leaflets ·2–·8″ long, the terminal usually largest, appressed hairy both sides, sometimes silvery beneath. Fls. small red clustered subsessile, heads dense sessile or shortly peduncled shorter than the leaf-rhachis. Ovary silky. Pod ·12–·17″ oblong thinly silky 2-seeded.

Chota Nagpur, frequent in waste places! Monghyr! Fl., Fr. Aug.-Nov.

8. **I. endecaphylla,** *Jacq.*

In general appearance very like forms of *I. enneaphylla,* with many prostrate stems up to 2 ft. long. Leaf-rhachis usually ·3–·8″ but in luxuriant plants up to 1·5″, lflts. narrow oblong-oblanceolate 5–11, usually ·15–·5″ long but attaining ·9″, strigose, mucronulate. Racemes longer than the leaves, many flowered, 1–2″ or up to 3″. Fls. ·16–·2″ long. Pods ·6–·9″ long with short slender beak, sometimes sub-four-angled.

Rare in our area. Behar, *Kurz*! Sirguja, *Clarke*! Fl., Fr. July-Jan.
Stipules scarious (as in *enneaphylla*). Bracts with setaceous tips, exceeding the buds, caducous. Calyx green, pilose. Corolla red, wings much shorter than the keel. Anthers greenish.

9. **I. pentaphylla,** *L.* Syn. I. glabra, *L.* (*Madras Flora*).

A rather variable diffuse often scraggy herb with numerous stems 8–15″ long, hairy or sparsely hairy all over except the pods. L. mem-

branous odd-pinnate with 7–3 leaflets, pairs opposite. Fls. small reddish or bright red usually 2–4 (rarely only one) in lax racemes with capillary peduncles ·3–·8″ long. Pod slender straight turgid ·7–1·2″ tipped with the hardened style base.

Frequent in Chota Nagpur, chiefly in sandy soils! Lohardaga and Parasnath, *Clarke*! Fl., Fr. July–Dec.

Hairs for the most part simple. Lflts. elliptic or obovate, large and small, small often only ·15″, large ·5–·7″, the larger ones often 3-nate. Pedicels very short. Calyx teeth three times the tube, silky. Standard ·12–·13″.

10. **I. hirsuta,** *L.*

A suffruticose herb 2–4 ft. high, whole plant covered with spreading hairs or hairs adpressed on the leaves, hairs mostly simple (basifixed). L. 7–9-foliolate, stipules filiform ·4–·5″, rhachis 2·5–3·5″, lflts. opposite obovate or oblong, end one largest 1–2″ with about 9 oblique sec. n. hairy both sides. Fls. pink in elongating racemes, 2–4″ long in fruit. Conspicuous from the close strongly reflexed terete hairy and pubescent pods ·5–·75″ long. Pedicels very short. Seeds about 5.

Common in Chota Nagpur in waste ground. Singbhum! Ranchi! Hazaribagh, *Clarke*! Palamau, Neterhat! Fl. r.s. Fr. Aug.–Dec.

11. **I. arrecta,** *Hochst.* Java and Natal Indigo.

An erect deep-green rather strict but leafy undershrub 3–6 ft. high with angled and grooved thinly strigose stems, pinnate leaves 4–5″ long with about 7 pairs and one odd leaflet and inconspicuous pink-red flowers in solitary axillary racemes 1·5″ long, gradually elongating to 2–3″ but only bearing pods near the base, which are straight and reflexed.

Cultivated in the indigo plantations and on the Ranchi plateau (for seed). Fls. Sept.–Oct. Fr. Nov.

Lflts. up to 17, median on the rhachis largest, ·7–1·5″, narrowly elliptic-oblong or oblanceolate thinly covered both sides with appressed short hairs, tip rounded or sub-acute mucronate, sec. n. 3–4 very faint. Stipules setaceous ·17″. Pedicels ·03–·07″ erect. Bracts setaceous, very caducous, ·03″. Fls. ·2″ long. Calyx strigose, shallowly campanulate, cleft less than half way down into 5 sharply lanceolate teeth. Standard greenish, ·2″, brown-hairy as also is the keel which is prominently spurred. Wings pink. Free parts of filaments alternately rather longer and more slender than intermediate four. Pod with very sparse appressed hairs 1″ long, about 8-seeded.

This is the indigo now generally grown in Bihar and Orissa. Most of the seed used in Behar and Tirhut now comes from Chota Nagpur or the United Provinces. When grown *in situ* the plants suffer from a disease called "wilt" and do not produce fertile seed (*Shillingford*).

12. **I. tinctoria,** *L.* Nil, *H.*; Sili bichi, *S.*; Wild indigo, or when cultivated, Ceylon Indigo.

A slender erect shrub 4–5 ft. high with weak sharply angled branches, odd-pinnate leaves, with two to four pairs of broadly elliptic or ell.-ovate membranous lflts. ·5–·9″ long and very slender axillary racemes of small red flowers ·17″ long. Pod straight or slightly curved (not seen in the Orissa plant) about 1″ long, pointed reflexed slender 10–12-seeded.

Wild in Orissa, Baruni Hill forest, under shade! Chota Nagpur, *Wood*, but almost certainly cultivated! Santal Parganas, *Camp.*, probably cultivated! Bengal, *J.D.H.*, without locality! Fl. Sept. Fr. Dec. Darbhanga and Purneah, cultivated specimens!

Branches with appressed hairs. Lflts. with rounded base and apex, usually nearly as broad as long but sometimes obovate or even oblanceolate and only ·4-·75″ with white sub-strigose hairs beneath and more delicate hairs above. sec. n. very fine not visible above. Petiolules ·05″. Stipules setaceous ·12″. Stipellæ 0. Racemes at first equalling the leaves, elongating to 5″ with very slender peduncles. Bracts setaceous ·05″. Pedicels about as long. Fls. ·22″ from tip of standard to tip of keel. Calyx hairy ·12″ equally 5-fid, teeth rather more than twice as long as tube, narrowly lanceolate acuminate. Standard sub-orbicular ·17″, keel spurred half-way up. Free parts of filaments 5 longer linear, 4 shorter lanceolate. Ovary hairy, 6-7-ovuled in Orissa specimen, 10-12-ovuled in Bihar specimens and pod usually 10-12-seeded.

13. **I. sumatrana,** *Gaertn.* Syn. I. tinctoria, *F.B.I.* in part; Nil, *H.*; Bengal Indigo.

Scarcely more than a variety of the last. A somewhat stouter shrub, leaflets 9-15, longer than broad, obovate to narrowly elliptic ·7-1″ or sometimes 1·5 by ·75″. Racemes 3-6″. Pods 1-1·25″ stouter than in last, usually ·1″ broad and somewhat curved, obtuse, 8-10-seeded, usually reflexed. Standard ·2″.

Occasionally spontaneous in Tamarisk jungles and on river banks in Tirhut, *Prain*. Purneah (see below)!

A form occurring as a wayside weed collected by me in Purneah has leaflets only ·4-·6″ long and spreading shorter pods only ·6-·8″ long with fewer seeds. It is probably a feral form.

14. **I. articulata,** *Gouan.* Syn. I cœrulea, *Roxb.*; I. argentea var. cœrulea *F.B.I.*; Surat Indigo.

Very distinct from the two last. Branches sericeous. Leaf rhachis 2·5-3″ with nearly always four pairs of obovate leaflets ·75-1″ long glabrous above. Racemes 1-2″ elongating to 3″ in fruit. Pods short and stout, somewhat like those of the wild *I. anil*, ·3-·4″ long only, curved sausage shaped, densely hairy.

Patna, *Ham.*! Formerly cultivated in Behar. Fl., Fr. Oct., Jan., April.

15. **I. pulchella,** *Roxb.* Syn. I. purpurascens, *Roxb.*; I. Jirahulia, *Ham.*; I. arborea, *Prain* (*Roxb.*?); Vern. Jirul, Jirahul, *Kharw.*; Hutar, Utar, *K.*; Dare Hutar, *S*; Kilberi, *Ur.*; Giral, Gibri, *Or.*

A much branched shrub 4-10 ft. high with odd-pinnate leaves 3-8″ long and 6-15 pairs of elliptic-oblong or oblong-obovate opp. and sub-opp. leaflets ·5-2·2″ long. Flowers pink or rose ·5-·6″ long in numerous dense racemes which are axillary and from the axils of fallen leaves, with long boat-shaped acuminate deciduous bracts covering the young buds. Calyx very oblique, often petaloid, broadly campanulate with lanceolate acuminate teeth. Pod straight slender 1-2″ long, usually reflexed.

Common throughout the province but chiefly in hilly country. Fls. Nov.-March, chiefly in Feb., when it is more or less leafless in the dryer localities. Fr. Feb.-April.

Branches rarely quite glabrescent. Lflts. often emarginate, apiculate, appressed hairy both sides, rounded both ends. Calyx usually hairy. Standard ell.-oblong ·5 by ·3″ neither clawed nor spurred, often with a white patch at the base.

There are two principal forms or varieties in our area:—

Var. *α*. **purpurascens,** *Roxb.* (sp.) = I. Jirahulia, *Ham.*

This is the common robust form with angled stems often quite hoary-hirsute when young but gradually becoming thinly appressed hairy or strigillose, the

eaves somewhat sericeous and the inflorescence often with erecto-patent or spreading hairs. Lflts. not at all obovate, much firmer than in the next variety, often very large, up to 2·2″ in exceptional cases. Bracts often far exceed the buds and end in long setaceous points. Standard with a white patch above claw at base not recognisable in herbaria).

Roxburgh says that it is a native of the interior of the Peninsula, and I have ound it in its best development on the hills and plateaux of the Central Provinces nd Chota Nagpur. (*Wall.* No. 5404 "e Loudon Gunti" is fairly typical, but *Wall.* 404 "e Siupur" differs in being less hairy, leaflets smaller and the bracts without he long tip.)

Var. β. **pulchella** proper.

It is a native of damper localities, has more terete branches, is more green and ar less hairy. Racemes less robust but more elongate often ultimately exceeding he leaves. Standard ·4″ relatively broader, without the white patch. Bracts without the long tip and therefore not exceeding the buds. Lflts. smaller, often omewhat obovate or ovate. Orissa!

NOTE.—All kinds of links connecting these two seem to be found (*Gamble's* No. 270 from Orissa is one) and there is doubt as to the correct specific name of the roup. *I. pulchella* was a Coromandel plant and *the type is not known*.* *I. arborea* dopted by *Prain* was a Srinagar (!) plant, and its description and figure moreover either appear to me to belong to our common Indian forms. *I. elliptica* appears be a glabrescent form, native of the eastern parts of Bengal. *I. purpurascens* almost certainly the plant described above and is also *Hamilton's Jirahulia*, but gainst the adoption of this name is the objection to replacing such a well-stablished one as *pulchella* (which is contemporaneous) unless it can be shown to pply to a different plant.

6. **I. Hamiltonii,** *Grah.* in *Wall. Cat.* (No. 5465). Syn. I. juncea, *Ham.*

An undershrub with numerous diffuse strigillose branches from he root (never densely hairy), with odd-pinnate leaves 1–3·5″ long ith 2–4 prs. (sometimes only 1 pr. on new shoots after jungle res) of orbicular or oval lflts. ·5–·6″ long. Fls. red or deep pink 4–·5″ long in long peduncled racemes exceeding the leaves, with anceolate concave caducous bracts ·1″. Calyx obliquely saucer-shaped embranous or petaloid with triangular or lanceolate puberulous and iliate teeth.

On the higher plateaux of Chota Nagpur 3000–3500 ft. Fl. April–June. Fr. June–uly.

Rhachis of leaf strigillose. Lflts. sometimes up to 6 pairs in unburnt specimens, inly sericeous beneath, rounded or retuse sometimes apiculate. Calyx up to ·15″ ng, posterior teeth rather shorter than anterior. Standard not clawed. Wings bliquely oblanceolate, slightly wider again at base with a callus and distinct claw, hich is often nearly at right angles to the axis of the petal. Keel with curved aws and spurs about half way up. Ovules about 10. Pod (in Oudh specimens) 1·5″ long, compressed and about 10-seeded.

I am doubtful whether this is always an undershrub. I have found a shrub on veral occasions up to 5 ft. high with 5–13-foliolate leaves and small roundish aflets which appears to me to be the unburnt form of this species, but inflorescence as not available.

8. PSORALEA, *L.*

Herbs or undershrubs with 1–3-foliolate leaves and repand or den-ate gland-dotted leaflets. Stipules large, stipellæ 0. Fls. in spikes r racemes often sub-capitate, often 2–3 together in the axils of embranous bracts. Calyx campanulate. Keel incurved obtuse. tamens 10 monadelphous or upper filament free, alternate free arts of filaments unequal. Ovary 1-ovuled. Pod ovate indehiscent.

*I have examined Kew, Calcutta, and the British Museum herbaria, and *Mr. Craib* forms me that the type is not in Edinburgh. It is unlikely therefore to be found.

1. **P. corylifolia,** *DC.* Babachi, *H.*; Barachi, *Beng.*; Bakuchi, *Or.* The seeds have been asked for under the vernacular name of "*satbara.*"

A coarse herb 2 ft. high with sparsely hairy striate branches, simple broadly ovate repand-dentate long-petioled leaves about 3·5 by 2·5″ and heads of small purple flowers on peduncles as long as or exceeding the leaves.

Occasional. Palamau, in the Sone valley! Less common elsewhere. Fl., Fr. Nov.-Dec., annual.

L. strongly nerved, punctate beneath, base obtuse. Spikes ·5-1″. Peduncles 2-4″. Fls. ·25″, calyx gland-dotted, anterior tooth half as long again as the others, wings exceeding the keel. Stamens with one filament free. Pod included densely gland-punctate and slightly hairy.

The seeds are laxative and stimulant. They yield a colourless essential oil.

9. TEPHROSIA, *Pers.*

Herbs, shrubs or usually undershrubs with odd pinnate leaves and opposite obliquely-parallel-nerved leaflets. Stipellæ small or 0. Fls. white or red usually in terminal or leaf-opposed racemes or sometimes also axillary. Calyx campanulate. Petals clawed, standard sub-orbicular, wings slightly adnate to the incurved keel petals. Stamens with vexillary filament connate above the base or free, anthers uniform. Ovary linear many ovuled, style incurved, often transversely flattened, glabrous or villous, with terminal often penicillate stigma. Pod linear compressed, not or slightly septate, dehiscent at both sutures. Seeds many, sometimes strophiolate.

I. Shrubs. Lflts. mostly over 1·3″ long :—
  Lflts. over 7 prs. Fls. white, ·75-·9″ . . . . 1. *candida.*
  Lflts. under 6 prs. Fls. red, ·4-·5″ . . . . 2. *tinctoria.*
II. Undershrubs. Lflts. under 1·3″. Style much flattened :—
  A. Pods thinly appressed-hairy or glabrescent :—
    1. Peduncles elongate with several nodes bearing 2-3 fls.
      a. Style hairy above. Fls. over ·4″ . . . . . 3. *maxima.*
      b. Style not hairy above. Fls. ·2-·3″.
        Erect bushy, densely sericeous. Fls. ·3-·35″ . . 4. *Hamiltonii.*
        Diffuse, sericeous. Fls. ·26-·3″ . . . . . 5*a*. *maritima.*
        Sub-erect, nearly glabrous. Fls. ·26-·25″ . . . 5. *purpurea.*
    2. Peduncles with 1-3 fls. only, under ·25″. Stems villous, procumbent . . . . 6. *pumila.*
  B. Pods with dense spreading hairs. Diffuse . . . . 7. *villosa.*

1. **T. candida,** *D.C.*

A weak shrub 5-8 ft. high with sulcate grey sericeous branches, odd-pinnate leaves with 7 to 14 prs. of narrowly oblong leaflets 1-2″ long which are grey- or white-silky beneath, and axillary and terminal elongate racemes 3-9″ long of pure white (or reddish, *F.B.I.*) drooping flowers ·75-1″. Pod 3-4″, brown, sericeous, slightly curved, 10-15-seeded.

Wild in the valleys of the Sameshwar Hills! Cultivated on the Ranchi plateau and other places. Fl. Aug.-Oct. Fr. Nov.-Dec.

A pretty plant when in full flower. L. rhachis 4-7″ long. Stipules ·3″ lanceolate erect with a setaceous tip. Lflts. somewhat narrowed each end, apiculate, with many oblique sec. n. uniting in the marginal one. Petiolules ·15″. Racemes short-peduncled. Pedicels ·3-·5″. Calyx rather oblique, ·25-·3″ long anteriorly with

triangular teeth as long as or shorter than the tube. Standard silky. Seeds smooth grey transversely oblong compressed ·15–·17″ with white strophiole.

The plant is often grown on tea gardens, and at the Kanki Farm, as a green manure. It is also grown as an ornament.

2. **T. tinctoria,** *Pers.*

A much branched undershrub 3–3·5 ft. high with angular shaggily hirsute branches, sessile 3–5-foliolate leaves with oblong leaflets 1–3·5″ long, densely grey silky-tomentose beneath, and axillary slender peduncles as long as the leaves with a short raceme of red flowers ·5″ long. Pod (unripe) 2–2·5″ linear-oblong flattened thinly silky. Seeds 8–10.

Neterhat plateau, Seemah forest, elev. 3000 ft.! Fl. Sept. Fr. Oct.–Nov.

L. rhachis ·7–1″, but sometimes a few simple obovate leaves on small lateral branches; petiole only 1″. Lflts. increasing in size from base to apex of the rhachis, lowest about 1″ and terminal 2–3·5″, all with very numerous spreading secondary nerves up to the margin and forming a marginal nerve and intermediate reticulations. Stipules erect ·2″ lanceolate acuminate strongly nerved. Peduncles axillary, 1·2–3″, with a close raceme ·3–·6″ long hirsute closely bracteate, the bracts being furnished with stipules like those of the leaves. Pedicels only about as long as the bracts. Calyx campanulate silky-hirsute with 5 subequal setaceous teeth equal to or exceeding the tube. Corolla fugacious. Standard very silky-pubescent with green claw, retuse. Wings half as long, and keel a little longer than the wings. Fil. very slender. Ovary villous. Style shortly hairy and stigma minute penicillate.

This plant has hitherto been reported only from the Western Peninsula, Ceylon and Birma and some varieties have as many as 13 leaflets. It has *axillary* racemes notwithstanding that *Baker* in his Key to the Leguminosæ (*F.B.I.*, p. 57) distinguishes *Tephrosia* generically by its having leaf-opposed racemes.

3. **T. maxima,** *Pers.* Syn. T. purpurea, var. maxima, *F.B.I.*

Erect (often prostrate, *Gamble*) 2–2·5 ft. high, not bushy. Stems usually few sparsely villosely hairy. Leaves 2–3·5″ with lanceolate usually reflexed acuminate stipules and 5–8 prs. of obcuneate leaflets with retuse apiculate tips. Corolla bright purple ·5″. Inflexed part of style villous. Pod nearly straight appressed puberulous or glabrescent, 2–2·5″, 10–12-seeded.

Open ground, Puri! Fl., Fr. Aug.–Oct.

Lflts. ·4–·65″ long thinly appressed villous beneath. Petiolules short but slender. Racemes terminal often 5″ long with distant nodes. Bracts small lanceolate shorter than the pedicels. Standard silky. Seeds ell.-oblong not reniform.

4. **T. Hamiltonii,** *Drummond.* Syn. T. purpurea, *F.B.I.* in part; T. sericea, *Ham.* Vern. names the same as for *purpurea.*

A bushy undershrub about 2 ft. high with angled sericeous or villous branches, sometimes flexuous. Leaf rhachis 2–2·5″. Stipules subulate-setaceous ·3–·36″ long. Lflts. 6–8 prs. oblanceolate to obovate closely sericeous beneath, ·6–1·3″ long, apex rounded straight or emarginate. Racemes terminal elongate with several nodes and often more than two flowers to a node. Bracts subulate shorter than the ·1–·14″ long pedicels. Calyx sub-appressed-hairy broadly campanulate ·12–·18″, teeth subequal subulate acuminate rather longer than tube. Corolla ·28–·38″ broad not emarginate grey purple, pubescent outside. Pod 1·3–1·6″ long slightly recurved above, with short appressed hairs, 6–7-seeded.

Common, often gregarious. Bihar and Chota Nagpur! Fl., Fr. Sept.–Dec.

This appears to be the *T. sericea* of *Hamilton*, but as that name is preoccupied I have adopted *Mr. Drummond's* name in the *Flora of Madras.*

5. **T. purpurea,** *Pers.* Sarphuka, *H., Kharw.*; Ban-nil, *Beng.*; Wild Indigo (of some Anglo-Indians).

Usually sub-erect with rounded glabrous or slightly hairy stems, filiform-subulate stipules, 5–7 prs. of oblong-cuneate glabrous or slightly appressed hairy leaflets with ·75–1″ long leaflets with rounded or slightly retuse mucronate apex. Fls. ·25″ long, purple, in elongate lax racemes up to 5″ long with three or more nodes, each bearing 1–3 fls. in the axils of setaceous bracts about as long as or shorter than the slender ·1–·16″ long pedicels. (The bracts are usually ternate, being the bract proper and its two stipules.) Calyx ·15–·16″ long strigosely hirsute with narrow-lanceolate or subulate finely acuminate teeth exceeding the tube. Standard ·15″, broad, blade scarcely broader than long, scarcely emarginate. Style transversely flattened and glabrous above (as in the rest of this group). Pod 1·5″ nearly straight erecto-patent appressed puberulous (glabrous in Willdenough's type), 6–10-seeded.

Waste ground, chiefly in sandy places. Common in Chota Nagpur! Fl., Fr. r.s. to c.s.

The branches are sometimes zig-zag.

Var. *a* **maritima.**

Sub-erect or diffuse, branchlets angled more hairy or sericeous. Stipules subulate. Lflts. 5–8 prs. oblanceolate, finely sericeous beneath, ·4–·55″. Fls. ·26–·3″ in many pairs, fascicles or single in the short bracts. Calyx broadly campanulate, thinly downy, teeth broadly lanceolate or lanceolate. Standard ·28″ diam., blade broader than long, distinctly emarginate. Pods much as in the type but spreading and reflexed.

Orissa, near the sea! Fl., Fr. May.

This is perhaps as distinct a species as *T. Hamiltonii*, but without more specimens it appears undesirable to separate it. It unites *purpurea* and *Hamiltonii*.

6. **T. pumila,** *Pers.* Syn. Galega diffusa, *Roxb.*

Diffuse with many procumbent villosely hairy branches. Stipules setaceous. Rhachis villous with seven or more pairs of obcuneate leaflets ·45–·7″ long densely sericeous beneath and less so above with rounded or emarginate apex. Fls. ·2–·25″, red, usually only about three towards the ends of slender peduncles. Calyx lobes setaceous-acuminate, twice as long as the tube, densely hairy. Standard suborbicular. Pod straight, nearly glabrous, 6–7-seeded.

Dry waste ground, Chota Nagpur! Fl. r.s. to c.s.

7. **T. villosa,** *Pers.* Syn. Galega villosa, *Roxb.*

Diffuse with flexuose somewhat hoary stems. Lflts. 6–8 prs., cuneate, somewhat emarginate. Stipules ensiform. Flowers in several prs. Pods much recurved, covered with white hairs, 5–6 seeded.

Behar, *Prain.*

I have seen no specimens from our area.

10. SESBANIA, *Pers.*

Herbs or shrubs or small soft-wooded trees, sometimes with small prickles. L. odd- or even-pinnate with very numerous narrow

leaflets and narrow stipules. Fls. usually rather small, very large in *S. grandiflora*, in lax axillary racemes. Calyx teeth short sub-equal. Corolla exserted, petals long-clawed, keel petals obtuse, or in *S. grandiflora* sub-rostrate. Stamens 9 + 1 with uniform anthers. Ovary linear, stipitate, many-ovuled, style filiform, incurved, glabrous. Pod very long linear, septate, dehiscent, many-seeded.

I. Flowers very large, white or sometimes red . . . . . . 1. *grandiflora.*
II. Flowers small or moderate-sized, under 1″.
  A. Woody perennials without prickles . . . . . . 2. *ægyptiaca.*
  B. Annual, often tall, scarcely woody, sometimes prickly.
    Tall. Fls. ·75″. Pod pendulous . . . . . . 3. *paludosa.*
    Often dwarf. Fls. ·4–·5″ long. Pod ascending . . . 4. *aculeata.*
    Diffuse. Pod erect . . . . 5. *uliginosa.*

The roots of the *Sesbanias* are copiously covered with large root tubercles which should make them a good green manure. The cotyledons are large epigeal, the first leaf is simple obovate or sub-three-lobed.

1. **S. grandiflora,** *Pers.* Syn. Agati grandiflora, *Desv.*; Agati, *Vern.*; Basna, *H.*; Buka, *Beng.*

A small tree attaining 25 ft. high and nearly 2 ft. girth with straight stem and spreading branches. Leaves 6–12″ long with 10–20 prs. of leaflets and an odd one. Lflts. linear-oblong about 1″ long. Flowers very large 3–4″ long white, or in one variety red, in lax 2–4-fld. racemes. Pods long slender curved, 12–18″.

Often cultivated in gardens but rarely lives more than 3 years. It grows best on black-cotton soil. Fls., Fr. chiefly c.s.

The young leaves are eaten but they are said to be aperient. The juice of the flowers is said to improve the sight when squeezed into the eyes. It is also a popular remedy for catarrh.

2. **S. ægyptiaca,** *Pers.* Jainti, *Beng.*

A large shrub or small straight tree attaining 15 ft. in height with pinnate leaves 4–6″ long ending in a point, 12–20 pairs of close-set linear oblong leaflets ·75–1·2″ long and yellow, or variegated with orange, red and deep purple, flowers ·5–·7″ in very lax axillary racemes. Pod twisted 6–9″ slender, thin, torulose.

Gardens and waste ground. Sometimes coming up as though wild. Fls. Oct.–Dec. Fr. Nov.–Jan.

Lflts. glabrous or sparsely appressed pubescent below. Flowers 2–10. Pedicels ·2–·4″. Standard sometimes nearly black outside, ·7″ broad.

It germinates readily from seed and only lives about three years giving a light shade, and may be used as a nurse to other plants, especially as it is copiously furnished with root tubercles.

The form with yellow flowers is considered the type, that with the standard dotted purple is sometimes called var. *picta* (*Prain*) and that with the deep purple or black standard var. *bicolor* (*W. & A.*).

3. **S. paludosa,** *Prain.* Syn. S. aculeata, var. paludosa, *F.B.I.*; Kathsola, *Beng.*

An erect annual 6–12 ft. high like a miniature tree, with a stout swollen tap root and lower part of stem swollen and pith-like, above green and shining. Leaves 6–12″ long with 10–30 prs. of oblong slightly tapering leaflets 1″ or more long, apiculate, thinly hairy beneath. Stipules caducous, semi-lanceolate. Flowers 1″ yellow with standard purple-dotted. Pod linear pendulous 10–12 inches long, somewhat spiral, slightly moniliform.

In jheels and swamps. This probably occurs in Purneah and Santal Parganas, but was included formerly under *S. aculeata* in my notes. Central Bengal, *Bengal Plants*. Fl., Fr. r.s.

4. **S. aculeata,** *Pers.* Syn. Æschynomene spinulosa, *Roxb.*; Chaipijan, *K.*

An erect annual somewhat resembling the last on a smaller scale, reaching 4–5 ft. in height and muricate or with small weak prickles on the branches and leaf rhachis. Leaves 6–12″ long with 20–40 prs. of linear leaflets ·2–·6″ long, obtuse apiculate, glabrous. Stipules minute, caducous. Fls. ·3–·5″ long. Pod ascending very slender 6–9″ long, beaked, straight sub-moniliform.

In wet places, common in the rains, all districts! Fl., Fr. Aug.-Oct.

5. **S. uliginosa,** *Roxb.*

Of this species, also, no separate record has been kept and there are no specimens from our area, although I believe I have often observed it The stems are diffuse. Lflts. ·1–·2″. Fls. ·2″, sometimes clustered. Pods sub-erect, 2·5-3·5″.

11. MILLETTIA, *W. & A.*

Trees or shrubs, often (in our area always) climbing, with odd-pinnate leaves. Stipellæ present or not. Flowers usually showy in axillary, often fascicled racemes, or racemes panicled and terminal. Calyx campanulate, lobes short or 0. Petals with long claws, standard broad. Stamens with vexillary filament free or connate only from the middle, anthers uniform. Ovary sessile linear few-ovuled. Style filiform incurved glabrous with capitate stigma. Pod linear or oblong, dehiscent or sub-indehiscent.

The species closely resemble those of the genus *Derris* in flower. The anthers in the latter genus are however versatile and stipellæ always absent.

Standard auricled. Pod flat, very tardily dehiscent . . . 1. *auriculata.*
Standard not auricled. Pod torulose, dehiscent . . . . 2. *racemosa.*

1. **M. auriculata,** *Baker.* Gaj, *H.*; Hehel, *K.*, *S.*; Gurar, *Kharw.*; Arkawla, *Or.*; Gora, Ganj, *Th.*

A large shrub, sub-erect or climbing, with leaves 1–2 ft. long and 3–4 prs. of strongly nerved leaflets thinly silky beneath. Fls. ·4–·5″, cream-coloured, fascicled on numerous racemes 4–9″ long, which are often clustered on short stout axillary peduncles. Pod flat, but not thin, woody, tomentose, 4–6″ by ·75″ with thickened sutures.

Throughout the whole province. In a semi-erect state often forming a dense undergrowth in many of the Sal forests in the valleys.

Fls. March-June. Fr. Jan.-March.

Innovations silky-tomentose. Lflts. obovate-oblong cuspidate 3-8″ long, terminal largest, sec. n. 8-12, stipellæ minute. Racemes dense silky. Pod very late in dehiscing.

It is cut as a fodder. The root, like some other species of *Milletia*, is used to kill fish. It is also used for killing insects on cattle sores.

2. **M. racemosa,** *Benth.* Gaj (confused with the last), *H.*; Jungi-nar, *Gond.*

A large climbing shrub with white bark on the branches; leaves about 1 foot long with 5–8 prs. of nearly glabrous lflts. Stipules large, filiform. Fls. cream or reddish ·4–·5″ in copious racemes

10–18″ long with very conspicuous villous setaceous subulate bracts ·3–·4″ long. Pods 4–8″ by ·3–·6″ linear, torulose with 2–4 tapering segments, black and readily dehiscent when ripe.

Chota Nagpur, chiefly in rocky ravines above 1500 ft., not common! Rajmehal Hills, rare! Rocky ravines in Angul, frequent! Puri, *Gamble*! Sambalpur, Jhargati forest! Fl. May–July. Fr. Jan.–March. Deciduous April.

Old bark brown and uneven. Blaze pink and pale-yellow. Shoots tomentose. Lflts. oblong-obovate sometimes wavy shortly often obtusely cuspidate, brown-silky along the mid-rib beneath, end one largest 3–4″ by 1·5–2″. Petiole thinly silky. Stipellæ setaceous. Petals glabrous, standard orbicular-elliptic, wings spurred. Ovary 6-ovuled.

Uses as in last.

12. ABRUS, *L.*

Climbing shrubs with multi-jugate deciduous leaflets and rhachis ending in a point. Fls. small or m.s. pedicelled fascicled on the swollen nodes of axillary racemes or short axillary branchlets. Calyx campanulate with very short teeth. Standard ovate short-clawed slightly adnate to the staminal tube. Stamens 9 in a slit tube (place of upper vacant). Ovary sub-sessile, ovules several. Pod flat or turgid.

Pod flat, seeds compressed. Lflts. oblong . . . . . . 1. *pulchellus.*
Pod turgid, seeds round. L. linear or linear-oblong . . . . 2. *precatorius.*

1. **A. pulchellus,** *Wall.*

A pretty climber, leaves with rhachis 3·5–5·5″ and oblong leaflets 8–15 prs., ·5–1·2″ by ·25–·5 or ·6″, apiculate, with appressed hairs beneath. Stipellæ minute subulate. Fls. pink ·48″ long, at first in short racemes but with the peduncle often attaining 6″ in fruit. Pods often geminate at the nodes 2·5–3″ long, thinly sericeous, about ·44″ broad. Seeds compressed ellipsoid ·2″ grey-black shining, in the hollows of a papery endocarp.

In the Northern Tract only. Champaran and Purneah! Fl. Aug.–Sept. Fr. Dec.–Jan.

2. **A. precatorius,** *L.* Kawet, *S.*; Karjani, *K.*; Karjain, *Kharw.*; Gumchi, rati (the seeds), *H.*; Sonkach, Kunch, *Beng.*; Runj, Gunja, *Or.*; Indian Liquorice; Crabs' Eyes (the seeds).

A pretty twining slender shrub with same habit as last, leaves 2–3·5″ long with 10–20 prs. of leaflets ·3–·7″, glabrous or silky beneath. Fls. usually a pale pinkish white ·3″ in crowded racemes 1–3″ long. Pods about 1·5″ long turgid. Seeds polished, usually a brilliant scarlet with a black eye but sometimes white.

Hedges and waste lands on bushes. Common in the Central and Southern tracts! Purneah! Fl. Aug.–Sept. Fr. Jan.–March or even May.

Very pretty in ripe fruit when the pods open and disclose the seeds.

These seeds contain a poisonous albuminous substance; the active principle, *abrin*, has been isolated. Powdered and the powder boiled in milk it is said to be a powerful tonic, uncooked it is purgative and emetic and in large doses gives rise to symptoms like cholera. The powdered seed is also said to be used by chamars for poisoning cattle by hypodermic introduction with a needle (sui). The root is made use of in the same way as liquorice root. The juice of fresh leaves is said to remove the spots of leucoderma. Indian medical works give several other uses.

The seeds, rati, are used by Indian jewellers as a weight; each is said to constantly weigh 1·75 grs.

13. CICER, *L.*

Annual herbs with usually odd-pinnate leaves and toothed leaflets. Stipules sometimes coarsely toothed, conspicuous, stipellæ 0. Flowers solitary axillary. Calyx-tube oblique, teeth sub-equal lanceolate. Stamens 9 + 1. Style beardless. Pod sessile oblong turgid, usually conical at tip, style persistent. Seeds with a slender funicle.

1. **C. arietinum,** *L.* Bhut, *S.*; Chota but, Butkalai, *Beng.*; Chana, *H.*; Moraijan, *K.*; Chicken-pea, Bengal gram, Horse gram.

A pretty herb about 1 ft. high, much branched and viscous hairy. Leaf rhachis 1–2″ long with small toothed strongly-nerved leaflets ·15–·3″ long. Fls. bluish-purple ·27–·3″ long on slender peduncles. Pod oblong ·75–1″ long, 2-seeded.

A common cold-weather crop. Fl. Jan.–Feb.

It is largely eaten and horses and sheep are largely fed on it. It contains much oxalic acid. The liquid obtained from macerating the seeds is tonic and antibilious.

14. VICIA, *L.* *Vetch.*

Herbs, usually climbing by means of a twisted tendril into which the end of the leaf or leaf-rhachis is modified, rarely erect or diffuse and rhachis ending in a point. Leaves even-pinnate. Fls. often showy, sometimes very small, axillary or in axillary racemes. Calyx campanulate, often oblique, teeth unequal. Corolla exserted, wings adnate at the middle to the shorter keel and to the staminal tube. Stamens 9 + 1, mouth of sheath very oblique. Ovary 2–many-ovuled, style filiform or slightly flattened, usually pubescent or bearded. Pod compressed, continuous within.

(The genus is chiefly one of temperate climates.)

I. Climbing or diffuse slender herbs. Rhachis ending in a tendril.
  A. Flowers few, very small, ·25″ or less.
    Lflts. 6–8 prs., pods hairy, 2-seeded . . . . . . 1. *hirsuta.*
    Lflts. 3–6 prs., pod glabrous, 3–8-seeded . . . . . 2. *tetrasperma.*
  B. Flowers ·75″, 1–2-axillary . . . . 3. *sativa.*
II. Stout, erect. Rhachis ending in a point or tendril . . . 4. *faba.*

1. **V. hirsuta,** *Koch.* The common Tare, Hairy Tare.

A graceful delicate climber with very numerous branches and slender leaves ending in branched tendrils. Lflts. alt. or opposite, usually 9–11 in our area, about ·3–·7″ long linear or somewhat broader upwards or linear-oblong. Fls. pale blue ·12″ long 1–6- but usually 4-flowered at the end of a slender peduncle. Style equally pubescent all round. Pod hairy oblong or rhomboid oblong ·25″–·35″ long, 2-seeded.

Fields, Bettiah! Champaran! Hazaribagh, *Wood*! Fl., Fr. Dec.–April.

2. **V. tetrasperma,** *Moench.* Syn. V. gemella, *Crantz.*; The Smooth Tare.

Habit similar but less graceful, leaflets usually 6–8 only, paired or not. Peduncles only 1–2-flowered. Fls. larger. Pod shortly stipitate glabrous 3–8-, usually 4-seeded.

Dinajpur district, on the edge of our area!

3. **V. sativa,** *L.* Ankari, *Beng.*; Rothi, *Or.*; Common Vetch.

A diffuse herb with angular stems, leaves hairy with rhachis ending in a short tendril, 4–6 prs. of obovate or oblong or linear-ligulate leaflets ·5–1″ long with truncate or retuse tip. Stipules semihastate often with a dark blotch, toothed or entire. Flowers ·75″ pale purple, solitary or paired, sub-sessile. Style bearded on the lower side near the tip. Pod linear 1·5–2″ flat, 8–10-seeded. Seeds sub-globose.

Not common but fairly general, from Behar to Angul! Said to be self-sown. Fl., Fr. c.s.

It is a favourite fodder with cattle. Often cultivated outside our area.

The variety with leaflets all elliptic- or ovate-oblong, the lower ones shorter and broader, is only known in cultivation.

Variety *angustifolia* has leaflets of upper leaves linear-lanceolate, lower ones obovate retuse or obcordate and more patent pods, and appears to be the form wild in temperate regions.

4. **V. faba,** *L.* Field Bean, also Broad or Windsor Bean.

Stem stout erect 1–2 feet high. Rhachis ending in a point or short tendril, leaflets 2–3 prs., 1·5–3″ long, elliptic-lanceolate. Flowers white 1″ long.

Cultivated in Bettiah, etc.! Native of Persia and the Caspian region.

15. LENS, *Gren. & Godr.*

Annual herbs differing from *Cicer* chiefly by the rhachis ending in a tendril or point, rarely with a terminal leaflet, lflts. entire, fls. sometimes shortly racemose, wings more or less adnate to the keel and to the staminal tube, the style bearded longitudinally on the inner face and by the short funicles.

1. **L. esculenta,** *Moench.* Cicer Lens, *Roxb.*; Ervum Lens, *F.B.I.*; Masur, Masuri dal, *H., Beng.*; The Lentil.

With somewhat of the habit of *Cicer arietinum*, 1–2 ft. Branches angular. Leaflets from 4–6 prs., sub-opposite, pubescent, lanceolate. The short axillary peduncle bears usually 2 small white or pale blue flowers and ends in a bristle. Pod oblong rhomboidal glabrous with two round compressed grey seeds with minute spots.

Cultivated largely in Behar, occasionally in other districts.

It is a valuable food and is said to have the property of preventing constipation.

16. LATHYRUS, *L.* Vetchling.

Scarcely differing from *Vicia* except that the staminal sheath is truncate and the style instead of being filiform is flattened upwards, always hairy beneath the stigma.

This is also chiefly a genus of the North Temperate zone.

1. **L. sativus,** *L.* Kansari, kesari, *H.*; Teora, *Beng.*; Chana, *Or.*

A very pretty little plant with winged stems. Leaves with 2 rarely 4 linear leaflets 1–2·5″ long and rhachis ending in a tendril. Stipules lanceolate with a sharply lanceolate auricle, very variable in size, from ·3″ to nearly 1″ including the auricles. Flowers solitary axillary bright blue ·75″. Pod dorsally 2-winged.

Sometimes cultivated as a second crop, but very general self-sown. Fl., Fr. Dec.-March.

It is largely eaten, but its continued use induces paralysis, *lathyrismus*, or hemiplegia, both in human beings and cattle. The toxic property has been traced to an alkaloid which is volatile and can be dissipated by heat. It should therefore be cooked at a high temperature.

2. **L. aphaca,** *L.*

An interesting little herb from the leaves being altogether reduced to tendrils at the base of which the large hastate ovate foliaceous stipules perform the function of leaflets. Fls. yellow, 1 rarely 2 axillary. Pods 1″ sub-falcate, seed black, smooth, compressed.

Bihar and Chota Nagpur, but rare. In cultivated fields. A native of Europe including the British Isles.

17. PISUM, *L.* Pea.

The genus differs from *Vicia* chiefly in the truncate staminal tube and in the style, which is hard, inflexed dilated above but with margins bent back forming more or less of a channel beneath; bearded below the stigma.

1. **P. arvense,** *L.* Matar, *H.*; Batura, *K.*; The Field Pea.

Leaflets 2–3 prs. sharply toothed often smaller than the large auricled foliaceous stipules. Standard pale purple or white, wings and keel purple. Seeds brown, marbled or (teste *Prain*) grey or purple, mottled, angular.

Cultivated in Chota Nagpur!

2. **P. sativum,** *L.* Matar, *H.*; The Garden Pea.

Closely resembling the last but flowers entirely white, seeds not angled, pale yellow or green.

Roxburgh says that this is the Patna or common white field pea, and the *Choota Mutur*, a small, round greenish variety of the common grey field pea. The former is cultivated extensively about Patna, and the other over every part of Bengal.

18. LESPEDEZA, *Mich.*

Shrubs or herbs with exstipellate 3-foliolate leaves. Flowers axillary or racemed. Calyx campanulate with narrow teeth. Corolla with broad standard. Stamens 9 + 1. Ovary only 1-ovuled with long slender incurved style and minute stigma. Pod of one small oblong compressed indehiscent reticulate joint.

Lflts. linear. Keel obtuse . . . . 1. *sericea.*
Lflts. obovate. Keel incurved acute . . . . 2. *macrostyla.*

1. **L. sericea,** *Miq.*

An undershrub with few long erect slender branches and close-set very shortly petioled leaves with linear-cuneate leaflets, in the axils of nearly all of which are abbreviated bracteolate racemes of 2–4 small white-purplish flowers ·17–·25″ long. Pod ·08–·1″ orbicular-oblong.

Bihar, *Kurz*! Neterhat, 3000 ft.! Fl. r.s. Fr. Dec.-Jan.

Stems sulcate, thinly hairy. Lflts. ·25–·7″ long with truncate or emarginate apex and a bristle in the sinus, with close ascending parallel lateral nerves, sericeous beneath. Racemes rarely elongating to one inch, bracts filiform persistent.

2. **L. macrostyla,** *Baker.*

A much branched shrub 3–4 ft. high with silky or densely pubescent branches clothed with short-petioled 3-foliolate leaves. Lflts. small obovate. Fls. pink ·4″ long in fascicles or very short racemes in the axils of the leaves or of bracts. Pod thin ·25–·3″ long.

On the top of the Sameshwar Hills (2884 ft.). Fl., Fr. Nov.–Dec.

Shoots densely silky tomentose. L. rhachis (with petiole) ·2–1″ only. Stipules ·1″ brown nerved lanceolate or ovate acuminate. Lflts. ·3–·8″ appressed hairy or sericeous beneath, glabrescent above, tip rounded or mostly emarginate with the strong mid-rib produced into a seta; sec. n. about 7 not clearly distinguishable from the very reticulate raised intermediate and tertiaries. Petiolules very short. Fascicles with a very short rhachis so that the fls. are really shortly racemose. Pedicels ·07″ elongating to ·2″ in fruit. Fls. opening one at a time. Calyx campanulate with teeth rather longer than the tube, lower 3 setaceous, upper combined lanceolate. Standard obovate ·3″ with green central spot, claw 0. Wings slightly adherent to the up-curved acute keel. Ovary densely bearded above with long hairy style which breaks above the base leaving an awn on the fruit. Pod oblong acute flattened villous, venose.

Distrib.: Himalayas, Simla and Garhwal to the Khasia Hills.

19. ALHAGI, *Desv.*

A low thorny shrub with simple leaves and small flowers in short racemes with a thorn-tipped rhachis. Calyx teeth short. Corolla exserted, standard obovate, wings free, keel incurved obtuse. Stamens 9 + 1. Ovary many-ovuled with filiform incurved style and capitate stigma. Pod linear, rather stout, indehiscent, septate and constricted between the seeds.

1. **A. camelorum,** *Fisch.* A. maurorum, *Desv.* Juwasa, *H.*

Thorns ·2–1·5″ long sometimes very slender. Leaves oblong mucronate obtuse drooping, ·4–·9″ rigid glabrous. Flowers ·3″ red in racemes 1–1·5″. Calyx glabrous ·1″. Pod 1″ straight or curved, moniliform.

Dry waste ground, Gya; Ganges banks, down to Patna, *Kew Herb.*! Near Monghyr, *Ham*! *Madden*!

The thorns usually are derived from one out of a pair of axillary buds and frequently develop as small branches. L. sometimes slightly hairy, in up-country specimens often only ·3″, base sometimes narrowed.

20. ZORNIA, *Gmel.*

Small herbs with pinnate leaves with only 1–2 pairs of leaflets more or less punctate beneath and small flowers in elongate racemes furnished with pairs of large foliaceous bracts. Calyx minute, teeth unequal, upper connate. Corolla exserted with acute incurved keel. Stamens monadelphous with dimorphous anthers. Ovary several-ovuled with filiform incurved style and minute stigma. Pod of one–several small round flattened sometimes finely muricate joints.

1. **Z. diphylla,** *Pers.*

A small wiry herb 6–12″ with comparatively long petioled 2-foliolate leaves with lanceolate leaflets ·5–1″ long and minute yellow flowers sessile between and hidden by the geminate peltately attached doubly-lanceolate bracts which are ·3–·4″ long and gland dotted like the leaves.

Chota Nagpur, open grassy places, common. Fl., Fr. r.s.
Branchlets and minute petiolules pubescent. Stipules small peltately attached deciduous. Bracts long-ciliate. Joints of pod often only one, very reticulato-venose, slightly bristly.

21. STYLOSANTHES, *Sw.*

Undershrubs or sub-herbaceous with pinnately 3-foliolate leaves and stipules sometimes adnate to the petiole. Flowers small in short capitate spikes. The structure of the flowers is remarkable, the calyx-tube being relatively very long and slender and there is an epicalyx of ciliated bracteoles at its base which in fruit simulate a true calyx. Calyx membranous, upper teeth more or less connate, anterior longer. Petals inserted in the throat of the calyx-tube or hypanthium, wing petals free or united at the tip. Stamens monadelphous, dimorphous, alternately with linear and very short anthers. Ovary subsessile 2–3-ovuled. Pod with 1–2 compressed rugose joints.

1. **S. mucronata,** *Willd.*

A procumbent herb or undershrub with a woody rootstock and spreading tough silky-villous branches 8–12″ long and small leaves with leaflets ·3″ long. Small yellow flowers ·2″ wide solitary in the axils of bracts which are arranged in short capitate spikes or are axillary. Pod very small woody beaked 1- or sometimes 2-jointed and -seeded.

Sand dunes of the Orissa coast! Fl., Fr. Aug.–Sept.
Petiole and rhachis ·23–·3″ adnate in its lower half to the connate cuspidate setose stipules. Lflts. rarely ·5″ slightly hairy and thinly silky, tip rounded or acute, mucronate; terminal with a minute but distinct petiolule above the rhachis, sec. n. about 4 oblique. Spikes ·25–·5″ sessile leaf-opposed, ultimately lateral and long-peduncled or at the end of a slender branch bearing 1–2 bract-leaves. Bracts various, lower petioled and stipulate like the leaves or lanceolate and pungent or reduced to the stipules which are persistent and striate. Calyx-tube ·25″ long, bracteoles ·13″ long.

22. ARACHIS, *L.* Ground Nut.

Herbs with even-pinnate leaves and usually only 2 pairs of leaflets. Stipules adnate to the petiole, stipellæ 0. Fls. yellow or white in a sessile axillary capitate spike, remarkable as in *Stylosanthes* by the very long slender hypanthium. Calyx-lobes 5, the 4 upper connate, the anterior free. Petals and stamens inserted on the throat of the hypanthium, keel incurved beaked. Stamens 9 or 10, monadelphous, 5 alternate anthers shorter and dorsifixed, others longer basifixed. Ovary 2–3-ovuled, raised after flowering by the elongating torus which finally becomes stalk-like and curves down towards the ground burying the fruit. Pod indehiscent with a thick reticulate pericarp.

1. **A. hypogea,** *L.* Chini-badam, mat-kalai, bilaiati-mung, *Vern.*

A small bushy plant. The well-known Earth-nut or Ground-nut.

Cultivated in all districts and becoming an increasingly important crop.
Probably native of Brazil.

23. SMITHIA, *Ait.*

Herbs or undershrubs with even- rarely odd-pinnate leaves and usually small leaflets, rhachis ending in a bristle when even-pinnate.

Stipules scarious, persistent, usually appendaged at the base. Flowers usually yellow, rarely bluish, in dense, more rarely lax, often unilateral racemes; bracts and bracteoles like the stipules. Calyx deeply 2-lipped, lips toothed or not. Corolla exserted, wings clawed and auricled. Stamens 5 + 5. Ovary many-ovuled, style filiform, stigma small. Pod of flattened or turgid 1-seeded joints folded together inside the calyx. Seeds reniform.

I. Flowers yellow. Calyx nerves parallel.
   Flowers collected into heads with their supporting leaves . 1. *conferta.*
   Flowers in peduncled heads, free of leaves . . . . 2. *sensitiva.*
II. Flowers blue-white, calyx nerves reticulate . . . . 3. *ciliata.*

1. **S. conferta,** *Sm.* Syn. S. geminiflora, var. conferta, *F.B.I.*

A herb with numerous spreading branches 12–18″ long with pinnate leaves ·7–1·5″ long, setose along the rhachis and midrib and margin of the linear-oblong leaflets, remarkable for the large persistent scarious stipules with long-tailed auricles. Fls. yellow clustered in the axils of the close-set terminal leaves of short lateral shoots, subsessile. Pod moniliform, the joints connected by the dorsal suture only.

Banks of rice fields, rivers, etc. Probably in all districts. Fl. Sept.–Oct. Fr. Oct.
Stems not bristly, much branched. Leaf rhachis with rigid setæ or bristles ·1″ long, and ending in a bristle. Lflts. 5–9 prs., ·3–·5″ long, tip rounded or acute, mid-rib ending in a seta, lateral nerves very obscure. Fls. capitate, subsessile, 2–7 together, ·4″ long; bracts and bracteoles resembling the calyx in texture. Bracteoles ·2″ obovate obtuse bristly and ending in a long bristle. Calyx lips ·3″ acute posterior slightly longer ovate or ell., scarious with numerous close parallel veins with a few bristles along mid-rib and apex. Corolla shortly exserted. Standard ·2″ broad, broadly oblong but narrow at base. Wings and keel petals oblong subsessile, spurred. Disc annular. Ovary deeply jointed. Pod about 7-jointed ·3″ long.

2. **S. sensitiva,** *Ait.*

A much branched procumbent elegant little plant with stems up to 1 or 2 ft. long. Leaves ·3–1″ sensitive, rhachis bristly and ending in a bristle, lflts. 4–12 rarely up to 20 linear ·15–·5″ long ciliate or bristle-ciliate on the midrib below and less so on margins. Flowers 1–6 in a close peduncled raceme with short ascending pedicels, bright yellow. Calyx with acute entire lips with a few short deciduous bristles, nerves close parallel. Corolla with a brown band in the throat. Joints of pod 4–6, face to face when ripe and papillose, or with small acute warts.

Purneah! Santal Par., *Gamble*! Singbhum! Manbhum! Not nearly as common as the last. Fl., Fr. Oct.–Nov.
Peduncles slender ·5–1″ usually longer than the leaves, racemes capitate ·3–·4″. Fruiting calyx with included pod ·25–·27″ with 2 bracteoles at base ·12″ long.

3. **S. ciliata,** *Royle.*

A delicate species with diffuse branches 4–10″ long. Leaves ·5–·7″ with 6–10 leaflets about ·3″ long or less, linear, close, bristle-ciliate on the midrib and less so on margins, minutely punctate. Fls. in small peduncled heads with reticulate-venose long ciliate calyx ·2″ long, upper lip truncate. Corolla bluish or bluish-white.

Frequent on the top of Parasnath! Fl., Fr. Sept.–Oct.

24. ÆSCHYNOMENE, *L.*

Erect herbs or undershrubs with pinnate leaves and very numerous close-set small linear leaflets. Flowers m.s. or small in sparse racemes with deeply 2-lipped calyx. Stamens 5 + 5, anthers uniform. Ovary stalked, linear, many-ovuled. Pod linear or linear-oblong stalked exserted, flat, articulate with several 1-seeded joints.

Stems slender. Fls. ·25–·35″ . . . . 1. *indica.*
Stems swollen. Fls. ·75″ . . . . 2. *aspera.*

1. Æ. indica, *L.*

An erect slender suffruticose annual 2–3 ft. high with numerous slender terete branches more or less scabrid with small worts or papillæ, slender pinnate leaves ·75–3″ long with close set minute leaflets ·1–·15″ long, small yellowish or white flowers in lax 1–4-fld. terminal racemes and linear-oblong 5–10-jointed pods 1–1·5″ long.

In wet places in the rains. Very common, and probably in all districts. Fl., Fr. Sept.–Nov.

Papillæ on stem, branches, leaf rhachis and usually pods crowned with a delicate deciduous hair, upper parts also glandular. Lflts. linear-oblong 20–30 prs. uppermost usually alternate, 1-nerved, mucronulate. Stipules ciliate-toothed, lanceolate ·2″ including the large auricle, deciduous. Fls. ·25–·35″ with a deciduous ovate toothed bract at base of pedicel and 2 oblong-lanceolate bracteoles at base of calyx, often gland-ciliate. Calyx membranous glabrous subequal ·17–·2″. Standard obovate nearly equal to wings and obtuse keel. Free part of filaments longer than connate portion. Joints of pod smooth or papillose and sometimes (in a Ranchi specimen) verrucose opposite the seed. Lower suture indented. Stalk of pod often ·3″ long.

(The *F.B.I.* calls the racemes axillary, but in my specimens they are terminal on an axillary branchlet, which has often however only one leaf.) (The leaflets are pellucid-dotted in boiled specimens.)

2. Æ. aspera, *L.* Shola, *H. Beng.*

A stout marsh herb with floating spongy stem, leaves 3–6″ long with 50–100 leaflets and corymbose simple or branched racemes 1·5–3″ long of yellow flowers ·75″ long. Pods 1·5–3″ by ·3″ broad smooth or usually warted or muricate on the faces.

In tanks and jheels chiefly in the North East. Purneah! Ranchi, not common! Fl. July–Sept. Fr. Oct.–Nov.

Stems often as thick as the thumb. Stipules ·3–·35″ lanceolate with large basal auricle. Lflts. linear ·3–·6″. Inflorescence, calyx and corolla hairy.

This is the plant from which "Shola" or "Solar" hats are made. The stems are also tied together and used as rafts.

25. ORMOCARPUM, *Beauv.*

Shrubs with odd-pinnate leaves with persistent striated stipules and bracts. Flowers m.s. in lax racemes. Calyx not distinctly 2-lipped, with two upper teeth deltoid, anterior lobes longer narrow. Stamens monadelphous or 5 + 5, if monadelphous sheath split above. Ovary linear few-ovuled. Pod of few indehiscent turgid linear or oblong joints, naked or with stout gland-tipped trichomes.

1. O. sennoides, *DC.*

A large shrub with weak sub-sarmentose branches, leaves about 3″ long with 7–11 leaflets ·5–1″ long. Fls. ·5″ yellow in very short

lax glandular pubescent racemes. Pods moniliform, muricate with stout trichomes having a capillary tip terminated by a viscid gland.

Baruni Hill Forest, Khurda! Fl. Aug.-Sept. Fr. Sept.-Oct.

Stems attain 4″ girth. Innovations closely pubescent with gland or hair-tipped trichomes, branchlets thinly covered with their bases. L. rhachis 1·5–2·7″ slender. Stipules lanceolar-setaceous ·2″ brown. Lflts. alt. oblong, rounded and somewhat retuse and apiculate at tip, rounded or obtuse at base, glabrous, glaucous beneath, sec. n. 4–5 obscure and soon branched. Petiolule ·03″ slender. Rhachis of raceme ·2–1·2″ slender bracteate, sometimes flexuous with small bracts at the angle. Pedicels very slender ·3–·4″. Fls. with two ovate-lanceolate bracteoles at the base. Calyx 5-lobed about half-way down, ·25″ long, anterior lobe longer than the others, more or less gland-hairy. Standard broadly-ovate sharply reflexed on the claw purple-veined obtuse. Wings spurred. Keel petals obtuse connate above, with long slender claws. St. monadelphous. Disc shortly tubular. Ovary shortly stipitate, hairy. Ovules about 4. Style slender, stigma minute. Pod 2–3″ long-stalked, and with a deciduous beak, both sutures equally indented, joints 2–4 narrowly elliptic, striate, the trichomes developing with the pod and much stronger than on the inflorescence.

26. ELEIOTIS, *DC.*

An annual herb with 1-foliolate leaves and small flowers in very lax axillary racemes. Calyx tube very short, teeth 5 sub-equal setaceous. Stamens 9 + 1. Ovary sub-sessile 1-ovuled with short, sometimes uncinate style thickened at the base. Pod of one membranous exserted elliptic-lanceolate or boat-shaped joint.

1. **E. sororia,** *DC.*

Procumbent with long trailing slender 3-angled stems and orbicular leaves often emarginate both ends, ·75–1·2″ broad thinly hairy beneath, petioles slender, stipules scarious lanceolate nerved, stipellæ minute. Racemes 2–3″ with spreading hairs and geminate usually opposite spreading filiform pedicels. Bracts elliptic nerved caducous. Fls. ·08″ long reddish. Pod ·25″ venose, sometimes purple streaked.

Dry sandy places, rare. Behar, *Kurz*! Fl., Fr. Sept.-Oct.

27. URARIA, *Desv.*

Herbs with perennial rootstock or undershrubs often with the habit of *Desmodium*. Leaves 1- to pinnately 9-foliolate. Flowers in short or very elongate racemes. Pedicels and setaceous lower calyx teeth hairy bristly or plumose. Stamens 9 + 1 often exserted from the keel. Pod of 2–8 small turgid 1-seeded indehiscent joints usually bent on one another so as to become more or less face to face when ripe.

I. Upper leaves with 5–9 narrow leaflets . . . . . 1. *picta.*
II. Upper leaves 3-foliolate, lower usually 1-foliolate.
  A. Racemes dense, plumose.
    Procumbent. Lflts. small orbicular . . . . . 2. *lagopodioides.*
    Erect. Lflts. large ovate, base cordate . . . . . 3. *alopecuroides.*
  B. Racemes lax elongate.
    Fls. ·2″. Pedicels ·1–·25″. Pod puberulous . . . 4. *hamosa.*
    Fls. ·4″. Pedicels ·5–·6″. Pod hairy . . . . . 5. *pulchra.*

1. **U. picta,** *Desv.*

An undershrub 2–4 ft. high with the upper leaves 5–9-foliolate and with linear leaflets 3·5–6″ long usually with a pale or purple cloud

along the centre. Fls. small red in dense terminal cylindrical racemes 3–4″ long.

Waste ground and open forest. Chota Nagpur, frequent! Behar, *Hope*! Probably in all districts. Fl. Aug.–Sept. Fr. Oct.

Stems pubescent. L. very variable on the same plant; the first are small and suborbicular, these are succeeded by 3–5-foliolate linear leaves but often also by large simple oblong-lanceolate leaves up to 6″ by 1·5″. Bracts dry many-nerved long-acuminate ciliate. Pedicels with hooked hairs and sepals with long spreading ones. Joints of pod hard polished grey.

2. **U. lagopodioides,** *Merr.*

Suffruticose herb with prostrate and ascending branches about 12″ long from a perennial woody stock. Leaves roundish or broadly oblong 1–2″, 1- and 3-foliolate intermixed, sometimes all simple. Heads dense 1–2″ long rarely 2·5″ oblong, conspicuous from the plumose persistent calyx teeth. Pod with oblong finely pubescent joints ·12″ long.

Common in forest and waste ground. Chota Nagpur! Sambalpur! Fl., Fr. Aug.–Oct.

3. **U. alopecuroides,** *Wight.* Syn. U. repanda, *F.B.I.*

Erect with much larger ovate cordate leaflets, terminal on the 3-foliolate leaves 2·5–3·75″ long, lateral smaller. Racemes 2–4″ very dense, in bud conspicuous from the long awned bracts and afterwards by the plumed pedicels and calyx-teeth.

Frequent. Chota Nagpur! Behar, *Kurz*! Fl. r.s.

4. **U. hamosa,** *Wall.* Salphani, *Or,*

An undershrub 3–5 ft. high with the habit of a *Desmodium* (and in some states apt to be confused with *D. laxiflorum* but hairs not appressed). Leaves simple and 3-foliolate, when 3-fol. then terminal much larger than the lateral, usually elliptic-ovate or -oblong 2–6″ by 1–3″ pale beneath with many fine but prominent parallel sec. n., terminal leaflet 2–6″ by 1–3″. Flowers ·3″ long, pink or purple, 1–3-nate, mostly paired on slender pedicels ·1–·25″ long in long rather lax racemes 4–8″ long, which are sometimes panicled. Calyx teeth slender hairy but not plumose in fruit. Pod 4–8-jointed, brown or slate-coloured, puberulous.

Throughout the area, frequent in the forests, esp. in valleys! Fls. Aug.–Oct. Fr. Oct.–Jan. Perennial.

Branches shortly pubescent, hairs of two kinds, straight, and shorter hooked or curved. Stipules erect ·3–·35″ with setaceous tips. Lflts. sometimes only 1″ long, rarely narrowly elliptic or ovate-lanceolate, base rounded or retuse, tip acute or obtuse, apiculate, appressed fulvous hairy on the nerves beneath. Sec. n. 10–18 in the terminal leaflet, reaching the margin, tertiaries scalariform, lateral lflts. usually less than half the terminal and elliptic. Stipellæ subulate-setaceous. Racemes brown glandular pubescent and hairy, when young closely covered with imbricating ovate or obovate orbicular long-cuspidate bracts, caducous before the flowers expand. Pedicels usually divaricate, curved in fruit. Calyx ·1–·12″, teeth finely acuminate longer than the tube.

A decoction of the leaves is used with other drugs in cases of fever in Sambalpur (Mudaliar), cp. *U. lagopodioides* and *Desmodium gangeticum*.

5. **U. pulchra,** *Haines,* in *Kew Bulletin* 8 of 1921.

A *Desmodium*-like, somewhat diffuse, shrub 3–4 ft. high with fulvous hairy branches and 3-foliolate leaves, terminal leaflet rather

larger than lateral, oblong, ell.-oblong or mostly somewhat obovate with rounded apex, 3–4·5″ long, thinly yellow hairy beneath and pretty white, lilac or blue 1–2-nate flowers ·4″ long on very slender ·5–·6″ long pedicels in long lax often panicled and glandular racemes 6–15″ long. Pod 5–7-jointed glandular and hairy.

Sameshwar Hills, Champaran! Fl. Nov. Fr. Dec.

Hairs long and short as in *U. hamosa.* Stipules ·3″ subulate setaceous. Lflts. with rounded base and very rounded apex, shortly apiculate. Sec. n. reaching the margin 7–11 in terminal leaflet. Lateral leaflets more than half as long as terminal and much the same shape. Stipellæ setaceous. Calyx more or less colour of corolla with 2 upper teeth nearly connate, with very few slender hairs and glabrescent. Keel ·4″ long.

28. ALYSICARPUS, *Neck.*

Herbs with usually 1-foliolate leaves and strongly-nerved dry calyx stipules and bracts. Fls. small in axillary racemes. Corolla included usually reddish. St. 2-adelphous. Ovary many-ovuled. Pod not or only slightly compressed, of several indehiscent 1-seeded joints. Seeds suborbicular or globose.

A. Calyx much longer than first joint of pod.
  I. Fls. sessile. Tall, erect; spikes villous . . . . 1. *pubescens.*
  II. Fls. pedicelled.
    a. Diffuse. Pod distinctly 4-cornered . . . . 2. *tetragonolobus.*
    b. Erect or diffuse. Joints of pod not angled in section.
      1. Fls. in distant pairs. Pods not rugose. L. usually linear, never broadly elliptic or oblong . . 3. *bupleurifolius.*
      2. Racemes often close. Pod rugose. L. rarely linear, often elliptic . . . . 4. *rugosus.*
B. Calyx not longer than first joint of pod (exc. sometimes in 5), leaves rarely linear.
  I. Stems with spreading hairs.
    Pod with globose joints . . . . 5. *monilifer.*
    Pod with compressed joints . . . . 7. *hamosus.*
  II. Stems without spreading hairs.
    Pod with cylindric joints, not constricted between . 6. *vaginalis.*

1. A. pubescens, *Law.*

Erect, up to 4 ft. high with linear 3-nerved hairy leaves ·8–2″ long, very short petioles, and dense villous spikes of flowers, the rhachis, bracts and calyx being all covered with dense soft hairs. Pod 3–4-jointed, deeply reticulated.

Western Behar, *Kurz*!

2. A. tetragonolobus, *Edgew.*

A small diffuse species with linear-oblong to ell.-oblong leaves ·7–1·5″ long appressed hairy beneath, the hairs leaving small dots or papillæ when they fall. Calyx densely villosely-ciliate, sepals acuminate. Pods several-jointed, much constricted between the joints, rugosely-ribbed with the ribs meeting in a longitudinal one on the faces so that the joints become sharply 4-angular in section.

Dryer parts of the province. Behar, *Kurz*! Fl. Oct. Fr. Dec.

Often a small plant only 3–4″ but attains 12″. The stems are hairy on one side with a line of appressed hairs. Some states resemble diffuse forms of *A. bupleurifolius.*

3. **A. bupleurifolius,** *DC.*

Erect slender 2–3 ft. high or small and diffuse with linear to linear-oblong leaves 1–2·5″ or 3″ long and very slender racemes 3–6″ long of distant pairs of shortly pedicelled red flowers ·25″ long. Calyx ·15–·2″, much longer than first joint of pod, ciliate at tip only or also at edges. Pod usually 2–4-jointed, joints with faint raised nerves not uniting in a facial longitudinal one and not angular in section.

Rather common. Fl. r.s. Fr. c.s.

The following forms occur:

Var. *α* **typica.**

Diffuse. L. linear acute glabrous.
Chota Nagpur and Santal P.!

Var. *β* **erecta.** (Syn. A. longifolius *W. & A.* in part.)

Erect. L. linear acute, with appressed hairs on midrib beneath. Pod 2-4-jointed ·2–·3″ long, minutely puberulous or glabrescent.
High hills and *pats* of Chota Nagpur, elev. 2-3000 ft.!

Var. *γ* **gracilis,** *Baker* (Edgew. sp.).

L. oblong-lanceolate or oblong, sub-obtuse, 1–2″ by ·5″. Calyx ·2″. Pod 1–2-jointed.
Hazaribagh, *Clarke*! Behar, *Kurz*!

Var. *δ* **intermedius.**

Diffuse, lower leaves sometimes elliptic, spikes less lax. Pod ·35″ with up to 6 joints.
Hazaribagh, *Clarke*!

4. **A. rugosus,** *DC.*

A diffuse or ascending very variable herb with broadly-elliptic, elliptic or oblong leaves ·5–2″ long, rarely more, with petiole ·15–·25″. Flowers pedicelled ·25–·3″ long with truncate or obtuse sepals, in dense or very dense, usually glabrous racemes. Pods turgid moniliform, included or slightly exserted, with 3–5 deeply transversely furrowed joints.

Widely distributed. Fl. r.s. Fr. c.s.

Var. *α* **typica.**

Stems attain 2 ft. in length. L. ell. or oblong glabrous or thinly hairy beneath. Spikes dense; bracts and sepals glabrous or somewhat hairy at the tips only, sometimes purplish, sepals obtuse about ·28″. The terminal spikes sometimes appear long and compound from the leaves dropping.
Purneah. Parasnath, *Clarke*!

Var. *β* **styracifolius,** *Baker.*

Diffuse 3–12″. L. broadly elliptic pubescent beneath ·5–·7″. Spikes short very dense or capitate, rhachis and calyx villous, pedicels very short, sepals acute.
Singbhum! Palamau! Gya, *Clarke*! Sahebganj, *S.P.*! Banks of Soane, *J.D.H.*

Var. *γ* **Heyneanus,** *Baker.*

Robust 3–4 ft. with stems and leaves pubescent, lower leaves oblong-obovate up to 2·3″, petiole ·3″, racemes more lax, mostly 2–4″ long.
Behar, *Kurz*!

5. **A. monilifer,** *DC.*

A small diffuse species with branches rarely exceeding 1 ft., leaves ·2–·5″ oblong or ell. often with cordate base, glabrous. Petiole ·12–·2″ hairy. Pod 3–6- or rarely 8-jointed ·5–·7″ long, globose joints minutely pubescent with curved hairs, calyx sometimes exceeding the first joint.

Hazaribagh, *Clarke*! Ranchi! Singbhum, common!

6. **A. vaginalis,** *DC.*

A diffuse or ascending variable species. Stems 6″–3 ft. with petioles relatively longer than in any of the preceding, and prominently septate pods not at all constricted at the joints ·5–·7″ long.

Throughout Chota Nagpur, all districts, common! Behar, *Kurz*! Monghir, *Ham. & Kurz*! Puri! Probably throughout the province.

Both leaves and inflorescence variable. *Prain* calls all specimens with lax inflorescence "*vaginalis*" and with dense heads "var. *nummularifolius*." *Baker* places the distinction on the leaves, var. *nummularifolius* having small often rounded leaves. L. vary from elliptic and broadly elliptic to lanceolate, oblong or even linear-oblong ·25–1·25″, thinly hairy beneath, base cordate. Petioles slender up to ·4″, often as long as leaf. Very rarely some of the leaves are 3-foliolate (var. *heterophylla*).

7. **A. hamosus,** *Edgew.*

Whole plant hairy with ascending branches rarely exceeding 1 ft., leaves large ·75–2″ rotund or broadly elliptic. Pods compressed and often continuous within as in *Desmodium triquetrum*!

Behar!

29. OUGEINIA, *Benth.*

A tree with pinnately 3-foliolate stipellate leaves and rather small flowers mostly 3-nate in the axils of bracts in dense fascicled racemes from the leaf axils and the old wood. Corolla exserted, standard orbicular, wings spurred slightly adnate to the obtuse keel. Stamens 9 + 1. Ovary many-ovuled, style incurved, subulate, stigma capitate. Pod linear or linear-oblong of 2–5 flat, large oblong joints or joints obscure. Seeds 1–5 compressed reniform.

1. **O. dalbergioides,** *Benth.* Ruta, Panjan, *K.*; Rot, *S.*; Sandan, Panan, *H.*; Bandhan, Tinsa (Sambalpur); Pandan, *Kharw.*; Banjan, *Or.*

Usually a small and rather crooked tree in our area. Branches slender, grey. Lflts. often sub-tomentose beneath, terminal ovate, orbicular or obovate 3–6″ long, obtuse, entire or crenate with 5–10 strong sec. n. Flowers often borne in great profusion, chiefly from the old wood, white or pink, on slender pedicels. Calyx campanulate with distinct teeth.

Throughout the area, from Bettiah! to Sambalpur! and Puri! Common in the hill regions. Fls. Feb.-April. Fr. May-June. Lfless. Feb.-April.

Blaze finely closely streaked with blood-red on a white ground and exuding a red juice. Large pieces are prized for the patura or hubs of the sagar wheels, and the wood is in great request for agricultural implements. The leaves are largely used for fodder. It grows best in the most southerly forests and on red clayey loams. *Roxburgh* says that the pillars of Madajee Scindia's palace at Oojein are made of it. *Gamble* gives the average weight as about 52 lb.

29a. PSEUDARTHRIA, *W. & A.*

An undershrub in all respects resembling a *Desmodium* except that the pod is neither jointed nor dehiscent but continuous within. *Baker* (*F.B.I.*, ii, 154) says that the sutures are not at all indented, but this is not correct, some pods being indented just like a *Desmodium*, so that either the species should be included in *Desmodium*, or some of the sub-genera of that genus should be retained as genera. I have adopted the former course (see *Sect. IV of Desmodium*). *Pteroloma* is a connecting link between *Pseudarthria* and *Desmodium* proper.

30. DESMODIUM, *Desv.*

Shrubs or herbs with pinnately 1–3-foliolate stipellate (exc. in 14 and 15) leaves and usually small flowers 1–3-nate in racemes (rarely 1–4 axillary in species of *Dicerma* and *Sagotia*). Calyx with two upper teeth often sub-connate. Corolla exserted, standard broad, wings more or less adherent to the obtuse (or acute in section *Pteroloma*) keel which is sometimes spurred. Upper stamen entirely or partially free, alternate 4 of the sheath-stamens often shorter and sometimes (section *Sagotia*) without anthers. Ovary several-, rarely only 2–3-ovuled. Style incurved, stigma capitellate. Pod usually much compressed and of one-seeded indehiscent joints with one or both sutures indented, more rarely dehiscent along one suture or rarely pod continuous within and sutures little or not indented (sections *Pteroloma* and *Pseudarthria*).

(As noted under *Pseudarthria* it appears to be inconsistent to separate off that genus from *Desmodium* and not some others of the sub-genera.)

KEY TO SECTIONS AND SPECIES.

I. Flowers in heads or umbels. Joints of pod indehiscent. Shrubs.
  A. *Section I. Phyllodium.* Flowers hidden by pairs of large foliaceous bracts. L. 3-foliolate . . . 1. *pulchellum.*
  B. *Sec. II. Dendrolobium.* Bracts minute, deciduous.
    Branches 3-quetrous very hairy. Sec. n. 10–20 . . 2. *cephalotes.*
    Branches sub-terete, young silky. Sec. n. 7–10 . . 3. *congestum.*
II. Flowers in elongate often panicled racemes. Pod indehiscent along the sutures. Erect or sub-erect (exc. No. 5).
  A. *Sec. III. Pteroloma.* L. 1-foliolate with broadly-winged petioles. Keel acute. Pod sometimes continuous within when ripe, sutures sometimes straight.
    Erect pod very hairy . . . . 4. *triquetrum.*
    Prostrate. Pod sub-glabrous . . . . . . 5. *pseudotriquetrum.*
  B. *Sec. IV. Pseudarthria.* L. 3-foliolate, petiole not winged. Pods continuous within and sutures usually straight . . . . 6. *viscidum.*
  C. *Sec. V. Desmodium proper.* L. 1–3-fol. Pods with several joints (over 4), closed and indehiscent, sutures indented.
    1. Leaves 3-foliolate.
      a. Joints of pod much longer than broad.
        Bracts linear-subulate. Joints 3–4 times longer than broad . . . . 7. *laxiflorum.*
        Bracts lanceolate. Joints twice longer than broad, densely hairy . . . . . 8. *barbatum.*

b. Joints scarcely longer than broad.
Stipules large auricled. Fls. minute ·1″ . **9.** ***diffusum.***
Stipules subulate. Fls. over ·2″ . . . 10. ***polycarpum.***
2. Leaves 1-foliolate. Joints about as broad as long.
Stems angled, hairs appressed. Leaves small, or if large, lanceolate-ovate . . . . . . 11. ***gangeticum.***
As in 11 but leaves large ovate . . . . . var. ***ramnagari.***
Stems terete, hirsute. L. large deltoidly ovate . 12. ***latifolium.***
III. Flowers small in short racemes or 1–4 axillary. Pods with only 1–2 joints, or, if more, separately dehiscent along the suture (exc. no. 15). Trailing herbs (exc. no. 13).
A. ***Sec. VI. Nicolsonia.*** L. 1-3-foliolate. Racemes dense, Joints of pod 2, widely dehiscent . . . . 13. ***brachystachyum.***
B. ***Sec. VII. Dicerma.*** L. 3-foliolate, exstipellate. Pod 2-jointed, indehiscent. Bracts minute . . . 14. ***biarticulatum.***
C. ***Sec. VIII. Sagotia.*** L. very small 3-foliolate, stipellate or not. Bracts large deciduous. Pod 2–5-jointed, dehiscent (exc. no. 15).
Fls. axillary, not racemed. Pod indehiscent . 15. ***triflorum.***
Fls. in very short lax racemes. Pods finally dehiscent 16. ***parvifolium.***
IV. ***Sec. IX. Pleurolobium.*** Shrubs or undershrubs with 3-1-foliolate leaves, large flowers in (often panicled) racemes. Pods dehiscent in a continuous line, indented but scarcely jointed.
Undershrub, side leaflets, if present, minute . . . 17. ***gyrans.***
Shrub. Side leaflets well developed . . . . . 18. ***gyroides.***

1. **D. pulchellum,** *Benth.* Bir kapi, *S.*

A shrub 3–5 ft. high with grey hairy branches, easily recognised by the inflorescence which far exceeds the leaves and bears double rows of pinnately 2-foliolate coriaceous foliaceous bracts, the rhachides of which end in a filiform point, and which bear in their axils fascicles of small white or yellowish flowers ·25″ long.

In the forests, in all districts, sometimes almost gregarious. Fl. Sept.–Nov. Fr. Jan.–Feb.

Lflts. three, shortly grey-hairy beneath and on the nerves above, end one ell.- or ovate-oblong 3–5″ long, often sinuate; sec. n. 7–10 with parallel cross tertiaries. Lateral leaflets about half as large. Bracts orbicular strongly nerved. Joints of pod usually 2.

2. **D. cephalotes,** *Wall.* Syn. Hedysarum cephalotes, *Roxb.*; Ramdataon, *Kharw.*

A shrub 3–6 ft. high with distinctly 3-cornered, hairy branches, elliptic acuminate leaflets with 10–20 fine prominent silky parallel nerves and numerous yellow or reddish flowers in dense axillary short-peduncled umbels sometimes running out into racemes from reduction of the leaves. Pod silky 4–6-jointed ·1–·12″ broad.

Rather common. N. tract, Purneah, etc.! Chota Nagpur, in valleys, all districts! Sambalpur! Fl. Aug.–Oct. Fr. Nov.–Jan.

Angles of stem often shaggy. Lflts. 3–6″ sometimes rather obovate, beautifully silky beneath when young, lateral half to three-fourths as long as terminal. Petiole 1–2″. Umbels many-flowered with linear-oblong acute or acuminate bracts ·1–·12″. Bracteoles linear or setaceous ·12″. Calyx-tube ·12″, anterior sepal long-acuminate ·15–·18″. Standard ·3″.

Var. **congestum,** *Prain.* More glabrous and pods glabrescent. This may be a hybrid with the next species but is easily distinguished in our province by the numerous sec. n. and general appearance. Chota Nagpur!

3. **D. congestum,** *Wall.* Syn. Hedysarum congestum, *Rottl.*; Hedysarum umbellatum, *Roxb.*

A large shrub 15–20 ft. with terete or very young obtusely 3-gonous, adpressed-silky branches, 3-foliolate leaves, and oblong or oblong-lanceolate or lanceolate acuminate leaflets 3–4·5″ glabrous beneath except on principal and sec. n., which are fewer and less prominent than in *D. cephalotes.* Fls. in dense axillary short-peduncled umbels. Pods ·7–1″ deeply indented, joints 4–6 (mostly 5) slightly silky or glabrous.

Mals of Orissa! Fl. Sept.–Oct. (probably). Fr. Nov.–Dec.

A much larger shrub than *D. cephalotes*, branches never shaggy or acutely angled. Lflts. glabrous above, pale beneath, about 2½–3 times as long as broad, lateral about two-thirds or three-fourths as long as end one, sec. n. 6–8. Petiole ·7–1″. Lateral petiolules ·07–·1″. Stipules ·2–·25″ lanceolate striate with a fine setaceous tip. Bracts narrow-lanceolate acuminate. Calyx-tube ·15″, anterior sepal with the midrib excurrent in a long filiform tip.

The differences between this species and *D. cephalotes* are well shown in *Roxburgh's* unpublished drawings.

4. **D. triquetrum,** *DC.* Syn. Pteroloma triquetrum, *Benth.*; Hedysarum alatum, *Roxb.*

An erect undershrub 3–6 ft. high with obtusely 3-angled branches, 1-foliolate leaves with an oblong rather coriaceous leaflet 2–7″ long, easily recognised by its short broadly-winged petiole, small blue or purple 1–3-nate fls. in axillary and terminal lax panicled racemes 4–8″ long, succeeded by linear-oblong compressed ultimately 4–7-jointed pods ·75–1·5″ long. Seeds falling out through the open end of the pod after the fall of one or more of the joints.

Purneah, in grassy jungles! Khurda (Jaimangal Forest)! and Mals of Orissa! Fl. Aug.–Sept. Fr. Dec.–March.

A very distinct species attaining 6 ft. in damp localities. Branches sometimes 4-angled, angles villous glabrescent. Leaflet acute or acuminate, base rounded or subcordate. Winged petiole ·7–1·3″ long by ·25–·45″ broad, 2-cuspidate at apex. Stipules ·5″ erect-lanceolate. Pedicels ·2–·25″. Calyx 4-cleft, upper lobe broad acute. Pod appressed hairy dehiscing transversely at each joint but lower joints usually connected by the sutures, which are only slightly indented, seeds falling out through the transverse chink or at the end of the pod. Seeds free ·07″ compressed white or yellow.

This section might be restored as a distinct genus or included in *Pseudarthria* which the seeds and pods exactly resemble, but the next species seems to have the normal pods of *Desmodium*.

5. **D. pseudotriquetrum,** *DC.* Syn. D. triquetrum, *F.B.I.* in part.

A diffuse undershrub very similar to but smaller in all its parts than *D. triquetrum,* from which its habit at once distinguishes it. Pods ·25″ broad, glabrous or puberulous on the faces, hirsute on the sutures. The joints are closed when young.

Northern Bengal, *Prain*; probably Purneah.

6. **D. viscidum,** *DC.* Syn. Pseudarthria viscida, *W. & A.*

An undershrub with slender ascending pubescent branches 2–3 ft. long, pinnately 3-foliolate leaves with rhomboid leaflets often broader than long, and slender terminal racemes of small bright red flowers ·15″ long on slender 2-nate pedicels. Inflorescence and small oblong

pods more or less glandular pubescent. Pods ·6–·8″ long pubescent and with many short hooked hairs on the straight or somewhat indented sutures, 4–6-seeded, slightly depressed between the seeds when dry and sometimes breaking across at the joints.

Puri, Khurda forests! Fl. Nov.–Dec. Fr. Dec.

Branches somewhat angled. Hairs long and straight mixed with very short and often hooked ones. L. rhachis including petiole 1·25–2″ pubescent. Terminal leaflet 1–2″ (2–4″ in some specimens outside our area), somewhat glaucous and thinly silky beneath and thinly hairy above. Lateral leaflets about half as large. Stipules ·2″ linear-setaceous, striate, hairy, ·2″. Stipellæ very small, setaceous. Racemes sometimes panicled, pedicels 2–3-nate, ·1–·2″ long, reddish. Calyx ·1″, red, teeth acuminate.

7. **D. laxiflorum,** *DC.*

An undershrub 3–4 ft. high with rather thin twiggy angled branches clothed with adpressed short hairs. Leaves occasionally 1-foliolate mixed with the others. Lflts. ovate-lanceolate, elliptic or rhomboid acute, scarcely acuminate, terminal 3·5–6″ by 1·5–3″, lateral about half as long, adpressed hairy beneath, scabrid-puberulous above. Racemes panicled 6–12″ long, lax. Fls. pretty, clustered on slender pedicels ·15–·37″ long, the standard white, the lower lip deep purple. Pod slender 6–8-jointed, covered with minute tubercle-based hairs, scarcely constricted, joints much longer than broad, about ·2 by ·08″.

Shady forests. Singbhum! Ranchi, Ichadag, elev. 2700 ft.! Manbhum, *Campbell*! Parasnath, *T. Thomson*! Rajmahal Hills, *Kurz*! Puri! Fl. Aug.–Sept. Fr. Dec.–Jan.

It is very apt to be mistaken for an *Uraria* in flower. Petiole slender pubescent 1·5–2″. Stipules persistent ·3″ lanceolate setaceous. Sec. n. of leaflets 9–11 strong, parallel, joining a marginal one. Pedicels reflexed in fruit. Calyx white or pink, tube ·05″ hairy, teeth longer. Standard ·2″ diam., keel ·2″ long. In Puri the flowers are bright pink.

The elastic stamens are enclosed in the keel petals and wings, and shoot the pollen to a distance when these are depressed.

8. **D. confertum,** *DC.*

A shrub with thinly adpressed-hairy branches, 3-foliolate leaves with obovate terminal leaflet 2·5–3·5″, remarkable for the fine raised reticulations beneath leaving only small pits between, and large flowers ·4″ long in curved secund axillary and terminal panicled racemes. Very distinct in fruit from the densely plumose pods.

Harna River Bank, Sameshwar Hills at low elevation! Fl. Nov.–Dec. Fr. Dec.–Feb.

A very distinct species in leaf, flower and fruit. Petiole about equalling the rhachis above the lateral leaflets ·5–1·3″. Lflts. silky beneath, obtuse, apiculate, lateral ell.-oblong about three-fourths the end one, sec. n. 4–5 oblique strong, margin thickened beneath. Racemes 3–4″, rhachis pubescent. Bracts ·25″ lanceolate. Pedicels ·2″. Calyx campanulate ·15–·17″, teeth 2 upper connate nearly to top, 3 lower lanceolate as long as tube. Standard obovate ·4″ by ·3″. Ovary densely villous 4-ovuled. Joints of pod ·3″–·4″ long, 3–4, longer than broad, concealed by the long hairs when young.

This is essentially a Himalayan species.

9. **D. diffusum,** *DC.*

A stout herb much branched from the base with 2–3 ft. high, somewhat diffuse, sulcate and angled hairy stems, 3-foliolate leaves

with very large oblong auricled and cuspidate stipules and many-nerved leaflets. Flowers very minute bluish in terminal panicled racemes in the axils of 3-nate small lanceolate bracts. Pod 5–6-jointed, joints sub-circular with minute hooked hairs.

Open ground. Singbhum, *Clarke*! Hazaribagh, *Wood*! Behar, *Kurz*! Santal P.! Fl., Fr. Sept.–Dec.

Lflts. ovate or ell.-oblong rounded both ends 2–3″ long, slightly hispidulous and with sparse adpressed hairs above, thinly sericeous and pubescent beneath. Sec. n. strong parallel about 8–10. Stipellæ large, exceeding the hairy petiolules. Fls. 2–3-nate.

A noticeable species from the large stipules and persistent bracts.

10. **D. polycarpum,** *DC.* Baephol, *S.*; Salpani, Krishnupani, *Or.*

An undershrub with an extensively creeping rootstock sending up numerous erect or ascending stems 1–2 ft. or sometimes 3–4 ft. high. Branches hairy. L. 3-foliolate with obovate or broadly ell.-oblong leaflets usually about 2″ by 1″. Flowers bright purple geminate or clustered in dense or rather lax terminal often panicled racemes 1–4″ long, conspicuous in bud by the closely imbricating concave lanceolate striate bracts ·25″ long which have a sub-aristate tip. Pods ·5–·8″ long by ·12″, brown, hairy, close and erect, 5–7-jointed.

Common, often forming an undergrowth in damp rather open forests, frequent in Sal forest throughout the province! Fl. Sept.–Oct. Fr. Nov.–Dec.

Hairs on stems appressed (see var.). Lflts. membranous, or sub-coriaceous, pale and thinly silky beneath, rounded both ends or somewhat retuse, mucronulate, 1–3″, side ones half to three-fourths as long as end one, sec. n. straight fine curving at the margin 5–7. Petiole as long or shorter than the side leaflets, angled, hairy. Stipules subulate setaceous ·2″. Inflorescence often glandular, hairy. Fls. ·2–·25″ on slender pedicels ·15–·25″ spreading or somewhat deflexed in flower, ascending or erect in fruit. Calyx ·08–·1″, 2 upper teeth combined except at tip, 3 lower narrower acuminate, longer than tube. Joints of pod not much longer than broad, lower suture indented about one-fourth width of pod.

Var. **trichocaulon.** D. trichocaulon, *DC.*

Branches with spreading hairs. Racemes laxer 2·5–6″, glandular. Fls. ·25–·3″. Calyx ·1″ reddish thinly hairy, lobes ovate longer than tube, sinus gibbous. Standard ·25″ broad obovate emarginate.

Hills of Chota Nagpur 3000 ft. and over, Ranchi (Ichadag)! Palamau (Adar and Neterhat)! Parasnath, *Prain*!

This plant is also said to be used medicinally in Bonai, but the different species of *Uraria* and *Desmodium* are much confused by the non-botanist.

11. **D. gangeticum,** *DC.* Tandi Bhidi Janetet', *S.*; Salpani, *Beng.*

Herbaceous or shrubby with somewhat angled stems, lanceolate oblong or narrowly-ovate, 1-foliolate leaves rather shortly petioled, gradually narrowed to an acute point and with rounded base, grey silky or nearly glabrous and glaucous beneath and very small flowers ·12–·2″ in ascending lax elongate slender axillary and terminal usually panicled racemes 6–12″ long. Pod curved ·5–·9″, 6–8-jointed, indented about half-way down on the lower suture, upper suture slightly indented, usually with minute hooked hairs on the faces.

Throughout the whole province, common in one form or another in both forest and waste land! Fl., Fr. most of the year, but chiefly May–Jan.

Very variable, diffuse or sub-erect, depauperated specimens have leaves only ·5–1·5″ (var. *maculatum*, *F.B.I.*), luxuriant forest plants have stems 3–4 ft. and

leaves 3-6″ long, upper surface glabrescent or somewhat scabrous or with few adpressed hairs, sec. n. 7-8 or up to 10 in the largest leaves rather strong beneath and reaching margin, often with intermediate shorter ones. Petiole ·5-1″ in the larger leaves, one-third to half as long as the leaves in the smaller ones. Stipules erect striate subulate with setaceous tips. Fls. purple or white, 2-several-nate, pedicels ·1-·15″. Bracts subulate, minute or as long as pedicel. Calyx ·08″, teeth as long as tube lanceolate or deltoid. Pods spreading.

Var. **maculatum,** *Baker.* (*D. maculatum DC.*) Stem under 1 foot. Leaflet often only 1″ or less, roundish or oblong with cordate base. Frequent!

Var. **ramnagari,** *Haines.*

Very robust with erect angled hairy stems and broadly ovate leaves 3-6″, densely hoary-sericeous beneath. Bracts setaceous ·15″. Pods more erect, less curved, constrictions reaching from the lower to the straight upper suture.

Ramnagar! Fr. Dec., flower not seen. It looks at first sight very different from the type and may be specifically distinct.

D. gangeticum is regarded in Hindu medicine as febrifuge and anti-catarrhal. It forms an ingredient of the compound decoction called "dasamula kvatha" which consists of ten drugs (*S.M.M.*).

12. **D. latifolium,** *DC.* Kursopani, *Or.*

An erect shrub 3-6 ft. high with densely hirsute terete branches, broadly ovate leaves of one softly-hairy membranous or coriaceous obtuse leaflet 3-6″ by 1·5-3·5″ with straight or cordate very broad base. Fls. purple ·16-·2″ in numerous axillary and terminal often panicled, dense very narrow racemes 2-7″ long, or panicles up to 18″. Pods 3-6-jointed, joints slightly longer than broad, about ·13″ long, pubescent and villous.

Frequent under shade. All districts! Fl., Fr. Aug.-Jan.

This species may best be distinguished from var. *ramnagari* of the last by its spreading hairs and more deltoidly ovate leaves with a very obtuse or rounded apex. Lflt. often repand, sometimes only 2″ in dry places. Sec. n. 6-8 of which one is basal. Stipules lanceolate with setaceous tip. Short hairs sometimes hooked as in the last species.

13. **D. brachystachyum,** *Grah.*

A herbaceous undershrub 1-2 ft. high with thinly appressed-hairy somewhat angular stems and mostly 1-foliolate leaves with the elliptic-oblong leaflet reflexed on the petiole, 1-1·7″ long, sericeous beneath and slightly so above, rounded or somewhat retuse. Fls. deep purple in axillary and terminal very short dense racemes ·5-1″ long with the pedicels sharply deflexed after flowering and calyces white-villous. Pod short of 1-3 joints only, widely dehiscent when ripe, and slightly hairy.

Usually under light cover in open jungles. Gaya! Singbhum, esp. Porahat! Hazaribagh, *Clarke*! Bonai, common undershrub, *Cooper*! Fl. Sept.-Oct. Fr. Dec.

Petiole ·5-·7″. Stipules ·2″, stipellæ setaceous. Petiolule hairy curved, thus reflexing the leaflet which has a rounded or retuse base. Bracts ovate acuminate persistent ·2″ and pedicels not quite as long. Calyx teeth nearly as long as corolla, standard ·12″ diam. Joints of pod ·1″ by ·06″. Seed shining yellow peppered red.

14. **D. biarticulatum,** *Benth.*

A small procumbent undershrub with spreading stems about a foot long from a long woody rootstock, small digitately 3-foliolate leaves with small leaflets ·2-·4″ long, grey silky beneath, small reddish flowers in short often branched terminal racemes and 2-jointed densely appressed-hairy pods with both sutures equally indented.

Sands of the Orissa sea-coast! Fl., Fr. Aug.-Sept.

Branches with adpressed hairs, often clothed below with the brown striate 2-fid ·1″ stipules. Petiole ·1-·12″. Lflts. oblong or obovate-oblong, rounded or somewhat retuse, sec. n. 4-5 faint not reaching the margin, minutely reticulate between, petiolules very minute hairy. Stipellæ 0. Racemes ·5-1·25″. Bracts ·05-·07″ subulate, striate, exceeding the short pedicels. Fls. mostly 2-nate, ·2″, 2-bracteolate. Calyx ·1″ tubular, sericeous, two upper teeth connate except at tip, 3 lower broadly lanceolate equally or slightly exceeding the tube, acute. Standard obovate. Wings and keel long-clawed. Joints of pod broadly ellipsoid ·22″ by 1·8.″

15. D. triflorum, *DC.*

A very slender procumbent and long-trailing herb, often rooting at the nodes. Stems with fine spreading hairs. Leaves very small 3-foliolate with obovate truncate or emarginate leaflets ·12-·5″ long with a few adpressed hairs beneath. Fls. minute, white or pink, not racemed, 1-4 together in the axils of the terminal leaves of small lateral branchlets, flowering pedicels ·25-·3″ long. Pods curved 3-5-jointed on filiform pedicels up to ·5″, joints hairy or nearly glabrous reticulate-veined, rather longer than broad.

Pastures and banks, very common. Fl., Fr. Aug.-Jan. and perhaps throughout the year.

Much resembles a small *trefoil*. Stipules conspicuous persistent ·1″ long lanceolate. Calyx ·12″ clothed with long silky hairs with very long teeth. The pod in this species does not seem to open.

16. D. parvifolium, *DC.*

A prostrate copiously-branched wiry herb with small or minute 1-3-foliolate leaves and oblong orbicular or elliptic leaflets under ·5″ sparsely appressed-hairy beneath and with excurrent mid-rib, slender petiole with long loose villi towards apex and glandular hairy lax racemes of pale violet flowers nearly ·25″ long on capillary pedicels ·3″. St. 9+1, alternate 4 without anthers. Pod 2-4-jointed, joints dehiscent not separating.

Neterhat plateau, near streams 3000 ft.! Fl. April-Oct. Fr. May-Nov.

Stems hairy above sometimes trailing for 2 ft. Petiole about as long as the leaflets. Stipules lanceolate brown, striate, as long as or shorter than the petiole. Leaflets dimorphous: in one form crowded and only about ·1″ and often orbicular, in the other up to ·5″ and elliptic. Stipellæ absent or most minute. Racemes very numerous, often short on small lateral shoots, ·7-2″ long, 2-14-fld., fls. 1-2-nate on a zigzag rhachis, buds with large imbricate deciduous boat-shaped or broadly ovate amplexicaul cuspidate bracts ·12″ long. Calyx ·15″ beaked in bud with the long-hairy linear setaceous teeth, two upper teeth connate for about one-fourth the total length of the calyx. Standard orbicular ·25″ broad, retuse, claw cuneate. Wings and keel shorter partly connate, keel petals spurred. Ovary thinly pilose. Ovules about 4. Joints of pod rarely 5, ·12″ by ·1″ puberulous, young glandular.

17. D. gyrans, *DC.* Gora Chand, *Beng.* The Telegraph Plant.

A sub-herbaceous perennial 3-4 ft. high, branches green glabrous. Leaves with an oblong or oblong-lanceolate terminal leaflet 3-4″ long and 0, 1 or 2 small very narrow side leaflets ·5-1″ long. Fls. rather large in axillary and terminal racemes 2-6″ long, the large bracts concealing the flower buds and forming a terminal club. Pod 1-1·5″ shortly pubescent slightly indented, continuously dehiscent along the ventral suture.

In the damper forests and on moist banks. Champaran and Purneah, in the open! Gaya! Chota Nagpur, frequent! Probably also in other forest tracts. Fl. Aug.-Nov. Fr. Oct.-Dec.

Lflts. nearly glabrous, sometimes flushed with white, base and apex rounded, sec. n. distinct but fine, tertiaries very inconspicuous. Stipules ·5″ setaceous from a broad base. Terminal raceme often branched. Fls. ·4–·5″.
The small side leaflets move by little jerks in damp warm weather.

18. **D. gyroides,** *DC.* Jatang sing, *M.*

A shrub 6–20 ft. high with softly hairy branches. Lflts. 1–3 often drooping, end one obovate rounded attaining 3·25 by 1·75″, side ones rarely 1·5″ long. Fls. ·5″ deep purple in short axillary and terminal racemes 1–2″ long, with large deciduous bracts as in the last.

Along river banks and in shady ravines. Champaran! Purneah! Singbhum, especially on the Porahat plateau! Common along streams at Neterhat (Ranchi and Palamau)! Fl. Aug.–Nov. Fr. Oct.–Jan.
Lflts. appressed hairy both sides, sec. n. 6–8 and tertiaries distinct. Terminal raceme often branched rarely elongating to 4″. Bracts ovate ·35″. Pod 1·25–2″ hairy, 6–10-seeded, lower suture indented, dehiscent as in the last.

31. FLEMINGIA, *Roxb.*

Shrubs or undershrubs or herbs with perennial rootstocks, digitately 3-foliolate or simple 1-foliolate leaves, gland-dotted beneath. Fls. rather small or m.s. in minute cymes or in racemes or panicles, sometimes with large conduplicate bracts. Calyx-teeth narrow. Corolla cream or yellow or red-veined. Stamens 9 + 1. Ovary sub-sessile 2-ovuled. Pods oval very inflated, without septa, containing two rounded estrophiolate seeds, funicle attached to centre of seed.

I. Leaves simple or 1-foliolate.
  A. Fls. in small cymes each hidden by a large conduplicate persistent bract
    Leaves broadly ovate . . . . 1. *chappar.*
    L. lanceolate. Petiole under ·3″ thick . . . . . 2. *bracteata.*
    L. lanceolate. Petiole over ·3″ slender . . . . 3. *strobilifera.*
  B. Fls. in small cymes on the rhachis of panicles with caducous small lanceolate bracts . . . . . 4. *paniculata.*
II. Leaves 3-foliolate. Inflorescence racemose.
  A. Erect or prostrate strict shrubs with lanceolate leaflets and 6–20 sec. n. (exc. sometimes in 7).
    Erect. Leaflets with 12–20 sec. n. Racemes 2–4″ . . 5. *stricta.*
    Erect. Lflt. with 6–10 sec. n. Racemes 1″ . . . . 6. *angustifolia.*
    Prostrate. Sec. n. sometimes few . . . . . . 7. *prostrata.*
  B. Erect branched shrubs with elliptic leaflets and under 6 sec. n.
    Leaf glands evanescent. Racemes 2–5″ . . . . 8. *semialata.*
    Leaf glands black persistent. Racemes 1–2·5″ . . . 9. *congesta.*
  C. Erect stemless. Leaflets large and broadly elliptic . 10. *nana.*
III. Leaves 3-foliolate. Inflorescence capitate . . . . 11. *involucrata.*

1 **F. chappar,** *Ham.* Ulu, *K., S.*; Galphuli, *Kharw.*; Rani dant-katta, *Or.*

An erect shrub 5–10 ft. high with pubescent branches, strongly-nerved orbicular-ovate cordate cuspidate leaves and axillary racemes of secund 2-seriate large folded bracts enclosing the small cymes of white flowers.

Not recorded from Northern area. Central and Southern areas, frequent in the forests, often forming a dense undergrowth. Chota Nagpur, all districts! Santal Parganahs, common! Rairakhol! Athmalik! Sambalpur, rather local! Mayurbhanj! Angul! The bracts are well developed in October but it does not actually flower until Jan.-March. Fr. April-May when the bracts are brown and dry. Deciduous April and renews leaves May and June.

Leaves 2-4″ each way, distinctly dotted and thinly silky in age beneath. Petioles ·75-1·25″ thickened both ends. Bracts ·75-1″ by 1·25-1·5″ broad when unfolded, cordate emarginate. Fls. ·3-·5″ opening singly in succession and then becoming visible between the parted margins of the bract, few in an umbel.
The wood is used for tooth-brushes.

2. **F. bracteata,** *Wight.* Syn. F. strobilifera, var. bracteata, *F.B.I.*

A shrub 1-3 ft. high with shaggily pubescent sharply angled branches, lanceolate or oblong-lanceolate acuminate leaves 3-7″ by 1-2·5″ with sub-cordate base and very short stout petioles under ·3″ and mostly terminal panicled racemes 2-5″ long of large folded deeply cordate bracts ·7-·8″ long which are softly hairy and (when unfolded) are over 1″ broad, usually all slightly emarginate and sometimes the lowest obscurely cuspidate. Pods ·3-·4″ thinly pubescent.

Frequent in the forests and usually in dryer places than *strobilifera*. Champaran! Chota Nagpur, all districts! Angul! Narsingpur! Kalahandi! Probably in all districts. Fl. Jan.-April. Fr. Oct.-Nov.

Leaves sometimes with very few glands beneath, base 3-nerved. Petiole usually only ·2-·25″ densely pubescent. Stipules sub-persistent linear-setaceous or subulate with a filiform tip ·5-1″. Racemes usually with a zigzag rhachis. Fls. ·25″ pinkish.
Roots sometimes given for epilepsy.

3. **F. strobilifera,** *R. Br.*

A bushy shrub 5-8 ft. high with appressed-silky terete or slightly angular branches, lanceolate or ovate-lanc. sub-acuminate leaves 3-6″ by 1-3″ with rounded base and slender petioles, and numerous axillary and terminal racemes 2-3·5″ long of folded membranous cordate bracts enclosing short few-flowered cymes ·5″ long of small white or purple flowers ·25-·3″ long.

Frequent in shady ravines Singbhum and Porahat forests esp. at 2000 ft.! Manbhum, *Ball*! Palamau, Neterhat 2500 ft.! Fl. Feb.-March. Fr. Mar.-April but the conspicuous bracteate inflorescence appears in December or earlier.

L. hairy on the 10-13 strong straight sec. n. beneath. Petiole slender ·5-·8″. Stipules very caducous, small. Bracts (unfolded) ovate cordate rounded, apiculate or shortly acuminate, usually about 1″ broad and ·6-·9″ long, puberulous. Calyx ·15-·2″ pubescent and hairy and glandular, teeth linear-lanceolate acuminate, lowest rather longer than others 2-3 times as long as tube. Pods ·3-·32″ pubescent.

Var. **nudiflora,** *Haines.* A very remarkable variety in which the bracts are open, or both open and folded, but caducous before the flowers expand. It is apt to be mistaken for *F. paniculata* after the bracts fall.
Saitba forest, Singbhum!

4. **F. paniculata,** *Wall.* Rani dantkatta, Salpini, *Or.*

A large shrub 4-12 ft. high with terete thinly pubescent or hairy branches, rather large ovate cordate and cuspidate membranous leaves or upper ovate-lanceolate. Stipules caducous. Fls. reddish in short rather dense axillary and terminal densely hairy panicles, bracts dry ovate to lanceolate ·2-·25″ strongly nerved, caducous.

Damp Forests. Singbhum and Porahat, not uncommon! Santal P.! Angul, common in the damper forests! Sambalpur, attains 12 ft. in the Tablai-Deogaon forest! Fl. Feb.-March.

Leaves 4-6·5″ long, rarely base nearly straight and oblique, glabrescent beneath except for the hairy nerves, glands inconspicuous, base 5-7-nerved, sec. n. 5-7 fine but prominent and tertiaries often sub-parallel. Petiole thickened each end ·75-1·5″ very hairy. Fls. usually fascicled on racemes 1-3″ long, which are sometimes subsolitary in the axils but usually clustered and panicled, the panicles when terminal attaining rarely 6″. Calyx-teeth long linear-acuminate nearly as long as the corolla which is generally pink. Pods ·5″, hairy.

5. **F. stricta,** *Roxb.* Also called Salpani in *Orya.*

A tall strict scarcely shrubby species 6–8 ft. high with large 3-foliolate leaves, lflts. lanceolate or elliptic acuminate mostly 6–11″ in length with a 1–3-nerved base and 12–20 fine strong parallel sec. n. above the base. Stipules 2–3″ long lanceolate caducous. Fls. purplish, veined, ·25–·35″ long in very dense erect axillary 1–2-nate racemes 2·5–4″ long conspicuous in bud by the densely imbricating brown linear-lanceolate bracts which overtop the buds and the very large basal bracts of the raceme which attain 1·2″ and are often embraced by the yet longer stipules.

In the damper forests usually under dense shade. N. Champaran! Ranchi! Singbhum! Puri! Angul, common! Narsingpur! Sambalpur (Katabaga forest)! Probably therefore throughout the whole province where the forest conditions still exist. Fl. Jan.–March. Fr. April.

Branches 3-quetrous. Lflts. hairy on the nerves beneath, lateral basal nerves never much stronger than the secondary nerves. Petiole 3-quetrous, often narrowly winged, 5–6″ long. Lower calyx tooth equalling or exceeding the corolla. Pod hairy ·38–·5″.

6. **F. angustifolia,** *Roxb.*

An erect undershrub 2–4 or 6 ft. high with tomentose obtusely 3-angled branches, 3-foliolate leaves and lanceolate leaflets 5–6·5″ long. Fls. in dense axillary and sub-terminal sometimes clustered sub-spicate racemes about 1″ long with sub-persistent dry villous bracts and very slender densely villous calyx lobes.

Ramnagar Forests, N. Champaran! Fl. Aug. Fr. Sept.–Dec.

Scarcely more than an erect form of *F. prostrata*, but if united with it then species nos. 8 and 9 should be united. Similar specimens were collected at Dehra Dun and North Oudh and included in *F. congesta* in the *Cal. Herb.* which it certainly is *not*. *Roxburgh's* type (not now existent) came from Hardwar, which is close to Dehra Dun.

Petioles 1–2″ 4-ridged below, widely channelled above roughly 3-angled as in last. Sec. n. 6 or more reach the margin, tertiaries strong raised, hairy (hairs not appressed as in *F. congesta*).

7. **F. prostrata,** *Roxb.* Syn. F. congesta var. semialata, *F.B.I.* in part.

A diffuse slightly branched undershrub with a woody rootstock, brown-tomentose angular branchlets, 3-foliolate leaves with angular not-winged petioles and narrowly lanceolate leaflets 2–4·5″ long. Fls. in dense sub-spicate axillary racemes about 1″ long with sub-persistent dry bracts and very slender densely villous calyx-lobes as long as or exceeding the corolla and pod.

Frequent in the forests. N. Champaran! Singbhum! Ranchi! Manbhum, common in the rather dry forests of Gobindpur sub-division!

Fl. Aug.–Oct. Fr. Oct.–Dec.

Branches 6″–2 ft. densely tomentose when young. Lflts. brown-hairy or pubescent beneath and thinly so above, lateral basal nerves short, sec. n. (of end leaflet) 4–7 reaching the margin. Petioles 3-angled 1–2″ hairy tomentose. Stipules lanceolate or subulate acuminate ·2–·4″.

8. **F. semialata,** *Roxb.* Syn. F. congesta var. semialata, *F.B.I.* Birbut, *S.*; Galphuli, *Birja.*

An erect shrub 4–6 ft. or attaining 9 ft., bushy with densely pubescent or closely villous glabrescent branches, 3-foliolate leaves with narrowly winged petiole, lflts. rhomboidly lanceolate or elliptic

glabrescent except on the nerves beneath and the glands disappearing with age. Fls. ·3–·4″ long in copious axillary 2–4-nate or branched villous racemes which elongate and become longer than the petioles and are often sub-panicled at the top of the branches.

Very common in moist forests throughout the province, attaining its best development at elevations of 2–3000 ft.!

Fls. Aug.–Jan. Fr. Oct.–Feb. Perennial, new shoots come out April or May.

Trunk attains 9″ girth in Chota Nagpur with red blaze. Young shoots densely silky. Petiole 1·5–4″. Lflts. usually 4–5·5″ but sometimes attain 8·5″ by 4·5″! acute or acuminate, base narrowed sub-cordate. Racemes 2–5″. Bracts dry ·25″. Calyx densely sericeous or villous, teeth 2–3 times as long as tube, lowest as long as corolla. Standard green with red stripes, wings pink, keel reddish. Pod ·4″ tomentose. Seeds 2 black shining, raphe basal not very large.

9. **F. congesta,** *Roxb.* *F. congesta, F.B.I.,* part only.

Resembling *F. semi-alata* but a smaller and less bushy plant, leaves very similar but petiole angled not winged or only with a narrow ridge-like wing, blade glabrescent between the nerves or slightly pubescent, glands small black numerous and persistent and similar glands on the calyx and young pod. Racemes always very short 1–2·5″ not as long as the petioles.

Not common. Bettiah, *Hieronymus*! Kalahandi!

Possibly only a variety of the last and is so like it in leaf that it may be much commoner than would appear from the above distribution. The nervation of both species is the same and very different from *F. angustifolia, i.e.* on the midrib there are about 5–6 slender oblique sec. n. which reach the margin and the tertiaries are fine and not prominent.

10. **F. nana,** *Roxb.*

A dwarf undershrub 1 ft. high with a very short brown tomentose stem springing annually from a woody rootstock; very large, rarely small, 3-foliolate leaves with long winged petioles and congested sometimes panicled racemes of small reddish flowers appearing before the leaves.

In damp forests. In most if not all districts of the Central and Southern tracts!

Fls. March–April. Fr. April–May. The leaves do not usually appear until the rains and they last until the succeeding February.

Lflts. broadly-elliptic or rhomboid 5–7″ long and often 5″ broad, not acuminate, lateral very oblique. Petiole sometimes 10″ long. Petiolules tomentose ·25″. Racemes 3–4″ densely pubescent, bracts caducous. Corolla ·25″, lowest sepal as long. Pods ·3–·5″. The inflorescence leaves a deep orange stain on the hand, especially in fruit, from the numerous red glands.

11. **F. involucrata,** *Bth.*

A strict undershrub 4–5 ft. high with pubescent branches, very shortly petioled 3-foliolate leaves with short narrowly-elliptic or elliptic leaflets and purple flowers about ·5″ long in dense hairy heads surrounded by strongly-nerved oblong acuminate bracts.

Grassy places in the forest. N. Champaran!

Fl. Oct.–Dec. Fr. Dec.–Feb. Dies down to the root after fruiting.

A very distinct species with petioles only ·2–·8″ long, leaflets 1·5–3·5″, pubescent beneath not 3-nerved, sec. n. 10–12. Heads very villous, with permanent dry brown striate bracts ·7–·8″ long.

32. ERIOSEMA. *DC.*

Shrubs or herbs, usually erect with 1–3-foliolate leaves. Flowers axillary 1–2 or racemed. Calyx-teeth 5 as long as tube. Corolla exsert, standard auricled, longer than the wings and slightly beaked keel. Stamens 2-adelphous. Ovary sessile 2-ovuled, style glabrous. Pod oblong turgid 1–2-seeded. Seeds oblique, funicle attached to the extremity of the linear hilum.

1. **E. chinense,** *Vogel.*

An erect very sparingly branched undershrub 1·5–3 ft. high covered with long hairs. L. 1-foliolate linear, very slightly tapering, 1–3″ long, silky beneath, with mid-rib and margins pilose. Stipules persistent filiform hairy ·25″. Flowers 1–2 axillary yellow ·2″ long in nearly all the leaf axils. Pod ·5″ clothed with long brown hairs, persistent with recurved valves after ripening.

In grassy forests, frequent in Chota Nagpur, ascending to 3000 ft.!
Fl. Aug.–Sept. Fr. Oct.–Nov.
The rootstock is said to be tuberous. The plant reminds one much of a *Crotalaria.*

33. RHYNCHOSIA, *Lour.*

Twining or sub-erect herbs or shrubs with pinnately 3-foliolate leaves gland-dotted beneath, with or without stipellæ. Stipules and bracts caducous. Flowers small or m.s., axillary and usually racemed. Calyx rarely somewhat accrescent (in *R. rufescens,* but never simulating a papilionaceous corolla, as in *Cylista*), tube short, teeth usually exceeding it, upper often more or less connate. Corolla included or exserted. Stamens 9 + 1. Ovary sub-sessile, 1–2-ovuled, style long, incurved, stigma capitate. Pod round or oblong, compressed or turgid, not or rarely septate. Funicle inserted in the centre of the seed which is reniform or sub-globose and with a small peltate, or large divided, strophiole.

A. Calyx-teeth, at least the lower, subulate or acuminate.
  Suffruticose climber, lflts. rhomboid, 2–3″ . . . . . 1. *bracteata.*
  Erect undershrub 2–4 ft. high, heterophyllous . . . . 2. *cana.*
  Slender twiner, lflts. under 1·7″. Racemes lax . . . . 3. *minima.*
  Slender twiner, lflts. under 1″. Racemes capitate . . . 4. *aurea.*
B. Calyx-lobes broadly oblong, corolla included . . . . 5. *rufescens.*

1. **R. bracteata,** *Bth.*

A suffruticose climber distinctly woody below, bearing a very strong resemblance to *Atylosia crassa,* with downy or grey-tomentose branches, rather large strongly-nerved leaflets, yellow flowers ·5–·6″ long, not paired, in very numerous often sub-panicled peduncled racemes usually longer than the leaves. Pod ·75–1·3″ compresssd obovoid- or oblanceolate-oblong glandular-pubescent and velvety, 2-seeded (neither septate nor peltately glandular as in *Atylosia crassa*).

Angul! Fl. Feb.–March. Fr. March–April.
Branches grooved. Lflts. attain 3″ by 3″ rhomboid cuspidate pubescent beneath and less so above, nervation strong. Stipules lanceolate ·1–·15″. Racemes often 5″, with glandular pubescence,* and deciduous ovate acuminate bracts exceeding

* *Baker* in *F.B.I.* states that the pubescence is not glandular.

the buds which are pubescent (not varnished as in *A. crassa*). Calyx densely glandular, campanulate tube ·2″, lower sepal long-acuminate ·25″, upper two connate into a 2-toothed lip. Standard ·3″ diam. 2-auricled. Seeds ·2″ shining.

2. **R. cana,** *DC.*

A sub-herbaceous undershrub erect about 4 ft. high villous and glandular-hairy, leaflets of two kinds, rhomboid obovate or oblong 1–2·5″, and small lanceolate-acuminate or linear. Fls. small yellow or reddish ·3″ (tip of standard to tip of keel) on 1–2-fld. short axillary peduncles, corolla twice as long as calyx. Pod ·4–·5″ oblong somewhat flattened neither septate nor lineate, sometimes slightly depressed between the seeds, minutely puberulous glabrescent.

Durgapur range, Angul, on sandstone, frequent! Gyra, *Thoms.* and *Anders.*! Fl., Fr. Dec.–March.

Very variable, the broad large-leaved form and the small linear-leaved form would be taken for different species but occasionally plants occur with both kinds of leaflets. Very glandular with stalked glands above, but the gland-hairs tend to disappear in some plants. Branches often whippy at the ends. Petiole ·3-1″. Lateral leaflets smaller than end one which is often 3 times as long as broad more or less hairy beneath, with stalked glands in small form. Peduncles ·1–·75″. Pedicels ·1″. Calyx 2-lipped, upper 2-lobed, lower with 3 subulate hairy teeth about twice as long as tube. Standard longer than wings and keel yellow streaked with red. Seed resembling that of *R. rufescens* and with a large divided strophiole.

3. **R. minima,** *DC.*

A very slender trailing or twining herb with angled puberulous stems, leaflets orbicular- or ovate-rhomboid mostly under 2″ long. Racemes laxly 3–8-fld. Fls. yellow ·3″ long, calyx minutely silky, teeth subulate-acuminate, corolla about twice as long as the upper teeth. Pod ·5–·7″ long, flattened, oblong-oblanceolate, slightly curved, pubescent (glabrescent, *F.B.I.*). Seeds brown mottled black, ·12–·14″ long.

Open jungles. Rajmehal Hills, *Kurz*! Koderma, Palamau, frequent! Fl. Sept. Fr. Nov.

Var. **laxiflora,** *Baker.*

Our specimens all belong to this variety which has ovate-lanceolate leaflets with deltoid base and are 1–2″ rarely 2·5″ long, the type being rounded at apex and rarely attaining 1″. They are not however glabrous (as described in *F.B.I.*) but minutely hispidulous. Stipules linear-lanceolate persistent. Racemes very lax, attaining 5·5″. Strophiole minute, peltate.

4. **Rhynchosia aurea,** *D.C.* Var. *capitata* is a small species only once recorded by *Kurz* from Behar. It is a slender twiner with small broadly rhomboid leaflets about ·7–1″ each way, very easily recognised by its flowers being aggregated in capitate racemes and by its square or orbicular membranous villous pods ·35–·4″ diam. closely striate with transverse raised lines.

5. **R. rufescens,** *DC.*

A scarcely woody rusty-pubescent often glandular-hairy climber with slender whip-like branches, rhomboid or ovate scarcely acuminate leaflets 1–2·5″ and very numerous lax few-flowered racemes of smallish yellow flowers, the corolla included in the large deeply 5-fid calyx which has broadly oblong segments ·3″ in flower attaining ·5″ in fruit. Pod beaked sub-quadrate oblong. Seed 1 subglobose mottled, with a large grooved strophiole.

Forests. Singbhum! Koderma, Hazaribagh, among rocks, frequent! Haripur forest, Puri! Durgapur Range, Angul! Fl., Fr. Dec.–March.

Stems sometimes woody below, gland-pubescent above. Leaflets sub-equal much reduced in size on the upper branches, terminal usually rhomboid-lanceolate, both sides pubescent, base 3-nerved, sec. n. 2–3, looped and with raised reticulations, glands very minute. Petiole 1–3″. Racemes 1·5–3″ long, laxly 3–5-fld. Standard sub-orbicular ·32″ broad with 2 small inflexed auricles above the claw, wings spurred oblanceolate. Ovary silky 1-ovuled, slender style swollen in middle.

34. CYLISTA, *Ait.*

A twining shrub closely allied to *Rhynchosia.* Fls. in axillary sometimes panicled racemes with lanceolate acuminate caducous bracts, differing from *Rhynchosia* in the excessive development of the persistent calyx, the lobes of which are at first sub-petaloid both in form and texture but become scarious. Anterior sepal boat-shaped, largest resembling the keel petals of a corolla, enlarging to 1 inch or more in fruit, upper two connate in an emarginate lip and the lateral shortest very obtuse. Ovary 1–3-ovuled* and pod small oblong keeled somewhat oblique, glandular, enclosed in the calyx. Seed not or very slightly strophiolate.

1. **C. scariosa,** *Ait.*

A somewhat extensive but scarcely woody climber with densely pubescent stems and petioles. Lflts. softly shortly hairy above pubescent beneath especially on the nerves, terminal rhomboid about 5·5″ by 4·5″ acuminate, base rounded on the petiolule. Fls. in very numerous sometimes branched racemes, yellowish and red. Calyx ·5″ and enlarging to over 1″, two posterior sepals resembling the standard of a corolla, the true corolla concealed within the calyx.

Angul, in the forests, especially climbing over undergrowth near open ravines! Athmalik! Fl. Nov., also Feb.–March (perhaps Nov.–March?).

Lflts. microscopically gland-dotted beneath, dull and rugose above; primary nerves 3, sec. n. about 4 on each side of mid-rib, tertiaries strong transverse and reticulate, lateral leaflets ovate, much broader below mid-rib, acuminate, larger about 4·5 by 3″. Stipellæ small setaceous or acicular, ·2–·25″. Pod ·4″ pubescent and glandular.

The Angul plant differs rather from type in the leaflets being glabrescent between the nervules and in the more slender racemes which attain 6″ in length.

Dunbaria circinalis, Baker, was found in the Jalpaiguri district, not in our area. The genus has been included by mistake in the Key.

36. ATYLOSIA, *W. & A.*

Erect or twining herbs or shrubs with pinnately or sub-digitately 3-foliolate leaves gland-dotted beneath, often exstipellate. Fls. small or m.s., axillary or racemed. Calyx-teeth distinct. Keel of corolla not beaked. Stamens 9+1. Ovary sessile with terete incurved glabrous or pubescent but not bearded style, and simple or capitate stigma. Pod linear or oblong, somewhat flattened, thick septate and with depressed lines between the seeds which have a conspicuous divided strophiole.

A. Erect shrub 3–6 ft. high. Pod minutely velvety . . . . 1. *cajanifolia.*
B. Twiners or suberect with twining branches.
  Suffruticose. Lflts. 2–4″. Fls. ·7″ . . . . . . 2. *crassa.*
  Herbaceous. Lflts. ovate 1–2″. Fls. ·5–·6″ . . . . 3. *platycarpa.*
  Herbaceous. Lflts. ell.-oblong ·5–1·5″. Fls. ·3″ . . . 4. *scarabæoides.*

* Wrongly described as 1-ovuled in all works consulted.

1. **A. cajanifolia,** *Haines* (*Jour. As. Soc.* xv, 7). Ban Arhar, *Or.*

An erect shrub 3–6 ft. very like *Cajanus indicus* in general appearance. Stems minutely pubescent angled by three decurrent lines from the nodes. Lflts. sub-digitate rhomboidly lanceolate very acute 3-nerved, lower 1·5–3″, uppermost often only ·5″. Fls. dull yellow about ·5″ long, 1–4 usually 2 on short or long axillary peduncles longer than the leaves. Pod 1–1·3 by ·4″ deeply groved 4–6-seeded, minutely velvety.

Forests of Southern range, Puri! Fl. Nov.–Dec. Fr. March–April. Sub-deciduous in the hot season.

Petiole ·5–1·5″. Lflts. pale, minutely pubescent, or sub-tomentose beneath, very acute, exstipellate, margin thickened, sec. n. about 4, tertiaries reticulate. Peduncles ·8–1·8″ long. Pedicels ·3″ long. Calyx ·15–·19″, teeth triangular. Corolla ·42–·45″. Standard purple brown veined at the back, corolla sometimes marcescent. Seeds ·17″ black shining with large strophiole.

2. **A. crassa,** *Prain.* Bir rambara, *K.*; Bir malhan, *S.*

A suffruticose climber with downy or tawny-tomentose stems, rather large strongly-nerved leaflets, yellow marcescent flowers ·7″ long in pedicelled pairs on short axillary and panicled racemes. Pod 1–1·8″ by ·4–·6″ with strong oblique furrows. Seeds 3–6.

Bettiah Forests, Champaran! Central tract, not unfrequent in the damper valleys; Porahat! Palamau! Manbhum! Ranchi ghats! Southern tract: Singbhum! Angul (Labangi)! Puri (Kahuri)! Fl. Jan.–March. Fr. March–April.

Branches grooved. Lflts. attain 4″ by 3·75″, terminal usually rhomboid, rugose above, yellow- or brown-pubescent, sec. n. 2–3 above the 3–5-nerved base and with strong cross nervules. Petiole 1–4″. Racemes 1–4″ usually panicled with large deciduous concave oblong paralled-nerved bracts ·5–·75″ long. Calyx ·3″, lobes ½–¾ths as long as tube, upper two combined into one obtuse or emarginate. Standard and wings auricled. Ovary yellow-glandular, margins pubescent. Seeds ·25″. Strophiole large.

3. **A platycarpa,** *Bth.*

A slender annual twiner with hairy stems, broadly ovate acute or acuminate leaflets 1–1·5 rarely 2″ long, fls. ·5–·6″ long subsolitary on axillary slender peduncles, pods oblong 1·2–1·5″ by ·5–·6″ compressed 4–5-seeded lineate not deeply furrowed, with deciduous spreading hairs.

Rare. On rocks in the Horhap Forest, Ranchi! Behar, *Kurz*! Fl. Aug. Fr. Oct.–Nov.

Rhachis of end leaflet about ·5″. Lflts. hairy with 3 slender basal nerves. Peduncles 1–2-fld. ·5–1·3″. Calyx narrow ·4–·5″ with long setaceous teeth, very hairy.

4. **A. scarabæoides,** *Benth.* Gaisani, *K.*; Bir horec', *S.*; Ban Kulthia, *Or.*

A copiously branched pubescent grey-green herb with flexuose ends to the branches or more usually with slender twining branches, small strongly-nerved leaflets, terminal elliptic- or obovate-oblong ·5–1·5″ or usually only 1″ long, smallish yellow or reddish flowers ·3″ long, the corolla not much exceeding the densely grey-silky calyx. Pods small oblong very hairy or silky ·75–1″ long, about 5-seeded.

Very common in somewhat open forest on clay soils, throughout the Central and Southern areas! I have not noted it from the Northern area but it probably occurs. Fl. Aug.–Dec. Fr. Oct.–April.

Stems pubescent. Lflts. with 3 primary nerves tomentose when young; the glands in some specimens almost evanescent: lateral somewhat smaller and somewhat oblique. Petiole usually shorter than the terminal leaflet which has a rounded apex. Stipels 0. Peduncles ·25–·75″ slender 1- few-flowered. Seeds under ·2″, grey-brown, oblong rounded.

The seeds are eaten but chiefly by children. *Campbell* says that the plant is given for diarrhœa in cattle.

37. CAJANUS, *DC.*

An erect shrub with m.s. racemed flowers. The genus differs from *Atylosia* in the non-strophiolate seeds. The ovary is sub-sessile and the depressions between the seeds oblique.

1. **C. indicus,** *Spreng.* Arhi, Arhar, *K., H.*; Pigeon Pea, Dal.

An erect shrub 4–8 ft. high with slender grey-silky grooved branches, hairy oblong-lanceolate leaflets 1·5–2·5″ long whitish beneath and yellow flowers ·75″ long in axillary racemes and terminal panicles. Filaments alternately longer and shorter. Pod 2–3″ long, silky, often with dark purple spots. Seeds 3–4 globose and the size of a small pea, pale brown.

Cultivated throughout the province, often on a large scale. Fl. r.s. Fr. c.s. but depending on the time of sowing. Perennial but usually grown as an annual. Probably a native of Africa.

The dal is highly esteemed and said to be easily digested but it is regarded as heating and apt to produce costiveness. The tender leaves are chewed in cases of aphthæ and spongy gums (*Nadkarni*). Lac has sometimes been grown upon it.

The first pair of leaves are opposite lanceolate gland-dotted beneath and stipulate. They are apt to be mistaken for cotyledons.

38. SHUTERIA, *W. & A.*

Climbers with 3-foliolate stipellate leaves and conspicuous persistent bracts and bracteoles. Fls. small or m.s., racemose. Calyx tube gibbous, teeth shorter. Standard not spurred, exceeding the spurred wings and united keel petals. Stamens 9 + 1. Ovary subsessile or stipitate, many-ovuled, style incurved filiform, beardless. Pod flat linear usually recurved.

1. **S. densiflora,** *Benth.*

A slender twiner with pubescent stems, very slender petioles membranous nearly glabrous ovate or rhomboid leaflets mostly 1–2·5″ long with very rounded or emarginate apex and small white and purple flowers in dense axillary fascicled racemes with brown striate bracts clothing the rhachis. Pod at first strap-shaped thin 1–1·2″ long, finally dehiscent with spirally wound valves brown glabrous, 6–8-seeded.

Singbhum, in the damper valleys, rare! Ranchi and Palamau, in valleys at about 3000 ft.! Fl. Dec.–Feb. Fr. Feb.–April.

Leaflets rather pale beneath, and one attaining 3″ by 2″, apiculate, base rhomboid, sec. n. very fine, rhachis very slender, stipellæ small setaceous. Racemes ·75–1·75″ long sessile with hairy rhachis, pedicels mostly geminate ·12″, bracteoles lanceolate as long as calyx, ·12–·2″ long. Standard ·3″.

39. DUMASIA, *DC.*

Slender climbers with the habit of *Shuteria* but bracts and stipules small and inconspicuous. Calyx-tube cylindrical with oblique subtruncate mouth, base gibbous. Petals sub-equal, standard spurred.

Wings and keel adherent with small limb and long claws. Ovary linear sub-stipitate, few-ovuled, style flattened upwards. Pod linear falcate, torulose.

1. **D. villosa,** *DC.*

A very slender twiner with thinly hairy stems. Lflts. membranous broadly ovate-oblong, terminal with sub-rhomboid or triangular base and rounded or obtuse apex. Flowers pale yellow ·6″ long in very slender racemes 1·5–3″ long, standard reflexed and deeply emarginate spurred above the long cuneate claw. Ovary sericeous, ovules 3–4. Pod 1–1·5″ long velvety or sub-glabrous.

Chota Nagpur. Ravines near Neterhat, elev. 3000 ft.! Parasnath! Fl. Oct.
Lflts. pale glaucous beneath and with short appressed hairs in our specimens var. *leiocarpa*), 1·5–2·5″, terminal larger than lateral, lateral with rounded or truncate base, all apiculate, rhachis slender, 1·5–2·2″ above the thickened petiole and ·5″ between the leaflets. Stipules erect linear-setaceous ·1″, stipellæ minute. Bracts and bracteoles minute. Calyx ·3–·35″ long. Pod in type velvety, in var. *leiocarpa* nearly glabrous. The type has not been found in our area.

40. GLYCINE, *L.*

Twining or sub-erect herbs with 3–7-foliolate stipellate leaves and blue or red flowers in axillary racemes. Corolla little-exserted, petals sub-equal, standard not distinctly spurred. Stamens monadelphous. Ovary many-ovuled, style short beardless. Pod linear or oblong, flat or rather turgid, few-seeded.

1. **G. hispida,** *Maxim.* Syn. Glycine Soja, *F.B.I.*; Dolichos Soja, *Roxb.*; Ram kurthi, *H.*; Gari kalai, *Beng.*; Hende disum horec', *S.*; The Soy Bean.

Suberect or trailing about 1–2 ft. high looking like a *Phaseolus* with very hirsute stems, petioles and inflorescence. Lflts. ovate or oblong-lanceolate or lanceolate about 3″ long, more or less hairy both sides, petiole very long, often 5–6″. Fls. ·2″ pale blue (or reddish, *F.B.I.*), in sessile very short and hirsute racemes not exceeding 1·5″, pedicels very short, calyx about ·15″ densely hairy. Pods oblong narrowed at the base, 1–1·5″ long, straight or slightly curved, hairy. Seeds 2 (–3) deep brown or black compressed ellipsoid ·35–·38″ long with hilum ·1″ long.

Occasionally cultivated, Purneah and S.P.! Manbhum. Fr. Oct., May.

41. TERAMNUS, *Sw.*

Slender twiners with 3-foliolate minutely stipellate leaves. Fls. in very slender racemes, corolla little exserted, petals subequal, standard not spurred. Stamens monadelphous or diadelphous with the 4 alternate anthers small or abortive. Pod linear with a short upcurved beak (persistent style), seeds several.

1. **T. labialis,** *Spreng.*

A very slender twiner with glabrescent branches. Lflts. very variable in size, sometimes only ·6–1·3″, at others 1–3″ long, elliptic or ovate or terminal somewhat obovate, thinly appressed-hairy beneath, sec. n. 3–4, petiole shorter than or equalling the terminal

leaflet. Racemes very slender 1·5–5″ with distant clustered or solitary flowers in the axils of small subulate bracts. Fls. about ·2″ long, calyx densely covered with adpressed white or tawny hairs, corolla pink purple or white. Ovary hispid. Pod narrow linear straight or slightly curved 1·5–2·2″ long thinly appressed hairy. Seeds red when fresh, black when dry, oblong, ·12″ long, about 10.

Widely distributed. Bihar, *J.D.H.*! Shahabad plains, *J.D.H.*! Gya, *Clarke*! Palamau! Manbhum! Monghyr, *Madden*. Fl. July–Sept. Fr. Oct.–Dec.

42. GRONA, *Lour.*

Twining herbs with stipellate, sometimes very narrow, 1-foliolate leaves and deciduous bracts and stipules. Fls. racemed, nodes of raceme slightly swollen. Calyx campanulate with narrow teeth, two upper shorter but not connate. Petals exserted, nearly equally long, standard and wings spurred. Stamens 9 + 1, anthers uniform. Style beardless. Pod linear compressed or turgid, septate.

1. **G. Grahami,** *Benth.*

A slender twiner with linear or lanceolate-oblong leaves attaining 7·5″ in length. Flowers reddish in distant pairs rarely some solitary, mostly geminate in short racemes. Pod compressed 2–2·3″ long densely hairy; seeds with a small strophiole, orbicular.

Ranchi, Biru, *Rev. Cardew*! Manbhum, *Campbell*! Bonai, frequent! Fl. Aug. Fr. Sept.

Leaflet hispid on the thickened marginal nerve and with deciduous hispid hairs beneath finally glabrescent and glaucous, sec. n. very numerous and nervules reticulate; petiole ·5–·7″ long, hairy, stipellæ acicular. Fls. ·4″ long, racemes usually one to three together, 1–3″ long. Lower calyx teeth much exceeding the tube, linear.

43. GALACTIA, *P. Br.*

Slender twiners with 3-foliolate stipellate leaves. Flowers racemed with the nodes of the raceme somewhat tumid. Calyx teeth linear or lanceolate, the two upper entirely connate into one. Corolla little exserted. St. 9 + 1. Style beardless. Pod linear flattened, sometimes curved, sub-septate. Seeds without strophiole.

1. **G. tenuiflora,** *W. & A.*

A slender climber with small elliptic leaflets ·4–1·5″ long, shortly silky and finely reticulate beneath. Fls. ·3″ in very few-fld. elongate and very slender racemes. Pods curved 1·2–1·5″ flat sericeous, seeds about 8.

Behar, *Kurz*! The only record.

Kurz's specimen belongs to variety *villosa* of *Baker* (*F.B.I.*) = *Galactia villosa*, *W. & A.*, which is distinguished by the leaflets being densely villous beneath and larger (attaining 3·5″ according to the *Madras Flora*), mucronate, sec. n. 7–8.

44. CANAVALIA, *DC.*

Large suffruticose twiners or prostrate herbs with stipellate 3-foliolate leaves and rather large flowers in racemes with tumid nodes. Calyx 2-lipped, upper lip entire or with 2 rounded lobes, lower 3-toothed. Standard larger or shorter than the wings and incurved obtuse keel. Stamens monadelphous, or posterior free at

base. Ovary many-ovuled, style beardless. Pod large linear or linear-oblong, somewhat compressed with the upper suture strongly 2-ribbed. Seeds large sub-compressed with linear hilum, enclosed in a thin papery endocarp.

On germination the large oblong fleshy cotyledons are somewhat epigeal, the first leaves are simple, opposite, deeply cordate and palminerved, with erect oblong interpetiolar stipules.

I. Lflts. ovate or oval, very few obovate, glabrous or nearly so.
  Lflts. ovate acute or acuminate with obtusely cuneate base. Seeds 1″, pink or red, compressed. . . . . 1. *ensiformis.*
  Lflts. oval or broadly-ovate, often obtuse, base rounded. Seeds ·7″, scarcely compressed, brown . . . . 2. *virosa.*
II. Lflts. orbicular-obovate, rounded or retuse, often with white silky hairs . . . . 3. *lineata.*

1. **C. ensiformis,** *DC.* Syn. Dolichos ensiformis, *L.*; Canavalia gladiata, *DC.*; Tihon, *K.*, *S.*; Makhan Sim, *Beng.*; The Sword Bean.

A climbing perennial with green glabrous stems, terminal leaflet 4–6″ long glabrous ovate usually shortly acuminate and with obtusely cuneate not rounded base. Fls. large white or pink. Calyx glabrous ·55–·6″ long, standard broadly oblong 1·3″ long and 1·4″ broad, wings 1·4″, long-clawed, slightly adnate to keel. Ovary slender silky below, swollen below the style. Ovules 10 or more. Pod usually 8–10″ long by 1·3″ broad. Seeds bright rose-pink ·8–·9″ long, rather strongly compressed.

Apparently wild along river valleys in the Angul jungles and cultivated in all districts! Fl. Aug.–Dec. Seed ripens March–April.

In cultivation the plant is somewhat variable, but chiefly in the length of the pod and number of the seeds; the measurements above given are chiefly those of the wild or feral Angul plant, the pod of which has a distinct curvature (in opposite direction) each end. The seed is always pink when ripe, though *Roxburgh* refers to a grey variety in Silhet.

The seed and the sliced fruit are eaten.

The plant is usually grown as an annual, as the natives say that the subsequent crops of seed are more or less poisonous! This is interesting in view of the next species being reputed poisonous. The seed germinates in June. The interpetiolar stipules of the first leaves are ·6″ long, oblong, sometimes 2-fid. The regular stipules are mere points.

2. **C. virosa,** *W. & A.* Syn. C. ensiformis var. virosa, *F.B.I.*; Dolichos virosus, *Roxb.*; Kath-sim, Kala-sim, *Beng.*; Mohrhorha, Bahara, *Or.*

A climbing perennial with usually reddish and tougher stems than in the last. Terminal leaflet 1·5–4″ long rarely 5·5″, broadly elliptic-oblong or broadly-ovate with a rounded tip and short cusp or obtuse, rarely acute or sub-acuminate, base rounded; usually with few scattered hispid hairs beneath and petiolules hairy. Flowers lilac-purple 1·2″ long usually reflexed in shorter but closer-flowered raceme than the last, calyx puberulous ·55″, standard sometimes 1·2″ broad not as long, with two strong calli above the claw. Wings 1″ adnate to keel at base, wavy. Ovary silky tapering into the style. Ovules about 10. Pod attaining 7″ by 1·5″ but often much smaller (4–5″) nearly straight, brownish when ripe. Seeds 4–8 ellipsoid or somewhat ovoid ·6–·7″ long and much less compressed than in ensiformis, marbled with light and darker brown, hilum ·5″ long.

In hedges and scrub forest, especially near the sides of ravines, common in the Southern Area but not elsewhere. Purneah! Puri! Angul! Fl. Aug.-Dec. Fr. ripens March and newly germinated seedlings may be found in April. These are very hairy.

The interpetiolar stipules of the first leaves are oblanceolate, ·4-·5″ long.

The character of obovate leaflets so often given to distinguish this species from the last is quite useless; it very rarely has obovate leaflets. The very distinct seeds on the other hand have not been usually noticed. In the forest the very frequently red stems and venation at once distinguish it.

The seeds are reputed poisonous, but the young pods are sometimes eaten.

3. **C. lineata,** *DC.* Syn. C. obtusifolia, *F.B.I.*

A prostrate plant with long stems several feet long (but not climbing) which at least when quite young are clothed with white silky hairs. Lflts. silky when very young, glabrescent, orbicular-obovate or orbicular, rounded or retuse, terminal 2-4″ long and broad. Fls. pink much as in *virosa* but in fewer fld. racemes which exceed the leaves. Pod straight 3-4″ long by 1″ broad, 4-6-seeded.

Sandy sea-shores from Balasore southwards! Fl. Oct.-Nov. Apparently dying down after fruiting in March. New shoots in May.

The stipules are somewhat better developed in this species, broadly ovate but very small.

The plant roots at the nodes and tends to bind the sand.

45. BUTEA, *Roxb.*

Trees, sub-erect shrubs or large woody climbers with pinnately 3-foliolate stipellate leaves. Flowers large or rather small fascicled on the tumid nodes of racemes or panicles. Calyx campanulate, teeth short or lanceolate. Petals sub-equal or unequal, keel incurved and acute or straight and obtuse. Stamens 9 + 1. Ovary 2-ovuled, style beardless. Pod much compressed oblong, the base sometimes sub-samaroid and the apex dehiscing round the terminal seed, sometimes seed more central and pod sub-indehiscent.

A. Flowers very large, red. Keel incurved, acute.
Tree. Lower calyx-teeth deltoid . . . . 1. *frondosa.*
Large climber. Lower calyx-teeth lanceolate . . . . . 2. *superba.*
B. Flowers not very large, keel little-curved, sub-obtuse.
Sub-erect shrub . . . . 3. *minor.*
C. Flowers rather small, cream-coloured. Keel straight, obtuse.
Large woody climber . . . . 4. *parviflora.*

1. **B. frondosa,** *Roxb.* Morud, *K.*; Murup', *S.*: Dhak, *H.*; Paras, Palas, *Beng.*; Porasu, Polas, *Or.*

A small or m.s. tree with usually crooked trunk and black nodose branchlets. Leaves rarely 1-foliolate. Lflts. coriaceous 4-8″ long and broad, with a markedly greyish appearance when seen from a distance, grey tomentose or pubescent beneath, shining above, terminal obovate rounded at apex, or emarginate lateral oblique and considerably smaller. Flowers scarlet and orange 1·5-2″ long, borne in great profusion on the usually leafless branches. Calyx velvety black, campanulate, coriaceous, upper lip sub-emarginate, lower with three deltoid teeth. Pod about 6″ long, velvety brown. Seed oval compressed brown, 1·5″ long.

Very common in the Central and Southern areas exc. Puri, and often gregarious in cultivated and waste lands esp. in Palamau and Hazaribagh. In the Northern area it becomes scarce in Purneah except towards the Morung but it is found sub-gregariously in some grass lands of Northern Champaran. Fl. Feb.-April, at least the upper part of the tree being leafless at the time. Fr. May-July.

On blazing the trees a red juice issues which hardens into a red astringent gum used in diarrhœa and in the indigo-beating vats. It is said to increase the outturn of indigo by 30–40 per cent. The trees are bled in May and June and the gum realises Rs. 6/- to Rs. 15/- per maund. The leaves are used for fodder and manure. The root bark gives a fibre and the flowers a yellow dye. It is one of the principal trees for lac cultivation. It grows easily from seed and succeeds best on cotton soil.

2. **B. superba,** *Roxb.* Morud, *K.*; Nari-murup, *S.*; Dorang, *Kharw.*; Noi Palas, Palsa-Noi, *Or.*; Budel, budhla, *Gond.*

A very large woody climber with the leaflets usually attaining 12–18″ and sometimes 20″ in young plants, sub-rugose and dull above, green and thinly (or young densely) hairy especially on the nerves beneath, terminal usually sub-rhomboid with obtuse apex. Flowers 1·75–2·5″ long, gorgeous orange scarlet borne in great profusion along the leafless branches on racemes often 12″ long. Calyx broadly campanulate, lower teeth lanceolate. Pod about 5″–6″.

Common in the hill forests of the Central and Southern areas in all the districts! Fl. March–April. Fr. June–July. Leafless Feb.–May.

It climbs from left to right with a trunk attaining 2–3 ft. girth. Bark rich brown, tardily flaking and hence generally smooth, the red juice as in *B. frondosa* contained in tubes between the bast fibres in the cortex; wood normal *without concentric rings*, with numerous med. rays, scattered large pores often sub-divided and other smaller ones. The spaces between the raised nerves beneath are minutely areolate with depressed nervules and the areoles are pale and glabrous, the appearance is therefore different to the leaflets of *Butea parviflora* which are sometimes confused with this. The fruit is very similar but can be distinguished by the character of the persistent calyx.

Roxburgh remarks that "the colours of the flowers are so vivid that my best painter has not been able, with his utmost skill, to imitate their brightness. When in flower, I do not think the vegetable world offers a more gaudy show."

3. **B. minor,** *Ham.* (*Wall. Cat.* 5439) inc. B. pellita, *H.f.* (*Kew. Bull.* 1908).

A large shrub with several long sub-sarmentose weak stems, not climbing. Stems without, or with very scanty, red juice, densely velvety with a close spreading indumentum, densely yellow-sericeous towards the inflorescence. Terminal leaflet 12–16″ broadly elliptic, with rounded not rhomboid base and acute rounded or emarginate apex, lateral similar but smaller and usually obliquely oblong, above sparsely hairy, beneath densely grey hairy-pubescent on the nerves but glabrescent between them with age. Fls. red ·9″ long in dense racemes which are usually panicled at the ends of the stems, both calyx and corolla densely yellow-sericeous. Pod sub-sessile oblong wider upwards 2–3″ by 1·25–1·4″ tomentosely hairy with the basal thin portion very short or almost absent.

Sameshwar Hills, N. Champaran 2000 ft., on sides of ravines! Fl. Sept.–Oct. Fr. Nov.–Jan. The whole plant dies back to the rootstock after fruiting.

A very interesting plant, never, where I have seen it, a climber. Lflts. with venation as in the other species with usually several sec. n. near the base. Petiole 6–8″. Stipules often persistent as semi-orbicular auricles 1″ broad. Rhachis of panicle angular. Pedicels ·5–·7″. Calyx ·3″ with very short teeth. Style hairy.

Eastern Himalayan specimens differ in some respects, especially in the more sericeous less hirsute tomentum, rather larger flowers and longer base to the pod. Our plant more resembles *B. pellita* but is close to *Hamilton's* type and collected near the same region, so that it is the Eastern form, not the Western, which requires renaming if the two are distinct. The description of *B. minor* in *Kew. Bull.*, 1908, appears to have been drawn up from the Eastern form, not from *Hamilton's* Nepal plant.

4. **B. parviflora,** *Roxb.* Syn. Spatholobus Roxburghii, *Benth.*; Bandu, Bandan, *K.*; Cihut, *S.*; Bibri, *Kharw.*; Maula, *H.*; Ram Borla, *Th.*; Murdha, *Or.* (When in leaf only it is often called by names applicable to *Butea superba.*)

A gigantic climber with the trunk attaining 3 ft. girth or more. Leaflets 5–10″ long, scarcely coriaceous, shortly densely silky or (var. *denudatus, Baker*) glabrescent beneath, terminal elliptic, sub-rhomboid or somewhat obovate, shortly cuspidate, sec. n. 8–10 strong and tertiaries scalariform. Fls. cream-coloured or white ·35″ long. Pod 3–4″ long, ferruginous-tomentose, sometimes constricted below the seed, base narrowed suddenly to a stipes ·5″ long.

Throughout the whole area but only common in the moister forests! Fl. Aug.–Dec. Fr. Feb.–March. Evergreen.

Bark smooth grey, wood with deep red concentric bast bands. The length and character of the leaf rhachis between the lateral and terminal leaflets is extremely variable, sometimes only ·3″ long and stout, at other times slender and 1·5″ long. Panicles tomentose, pedicels under ·1″. Calyx narrowly campanulate (by this character the inflorescence can be distinguished from *B. superba* in fruit), pale tomentose, lower teeth sometimes exceeding the tube, linear-lanceolate.

The seeds give an oil used for cooking and anointing. The bark gives a fibre. The red gum resembles that of *B. frondosa* and lac is sometimes collected both from this and the large-flowered *Buteas.*

46. PUERARIA, *DC.*

Large woody climbers or twining herbs with stipellate 3-foliolate leaves, leaflets sometimes lobed. Flowers large or small fascicled on the tumid nodes of long often panicled racemes. Two upper calyx teeth connate. Corolla far exserted, standard spurred or not at base, clawed, about equalling the wings and keel. Stamens monadelphous or distinctly diadelphous, anthers uniform. Ovary not or scarcely stipitate, many-ovuled, style filiform incurved beardless, stigma capitellate. Pod linear, more or less compressed, sometimes constricted between seeds.

Large woody climber flowering when leafless . . . . . 1. *tuberosa.*
Slender climber flowering with the leaves . . . . . . 2. *phaseoloides.*

1. **P. tuberosa,** *DC.* Jan Tshira or Chirra, *S.*; Pathal Kohnra, *Kharw.*; Pathal, Badra, *Gond.*; Ban Kumra, *H.*; Shimia batraji, *Beng.* (teste *Beng. Pl.*); Handiphuta, Kataka, Buinka Karkaru, *Or.*; Marda tunga, *Khond.*

A very large woody climber flowering when leafless and then very handsome. Lflts. large 6–12″ roundish or, more usually, the terminal one rhomboid longer than broad and the lateral very obliquely ovate, easily recognised from other similar woody climbers in the province by being permanently appressed white silky beneath and with scattered thinner appressed hairs also above, the stipellæ are also lanceolate-subulate ·2–·3″ long on the young leaves though they become more inconspicuous with age. Fls. blue-purple ternate on the nodes of racemes 6–18″ long. Calyx ·3″ purple or green, silky. Standard orbicular, clawed, often white, ·5″ long, slightly spurred or not, sides often revolute and apex emarginate. Stamens usually diadelphous 9 + 1. Pod 2–3″ long, hairy.

Central and Southern area, chiefly on the sides of rocky streams. Hazaribagh, *Meebold*! Parasnath! Manbhum, *Camp.*! Ranchi! Palamau! Puri! Angul! Sambalpur! Kalahandi, *Cooper*! Fl. Feb.–April. Fr. May–June. The leaves drop December to February and are renewed in May.

Tubers usually several, attached to the base of the stem by stout lateral roots and again ending in roots. They thus remind one of the Yams and are probably

morphologically roots, the shape is usually globose-oblong. Stems attain 2 ft. girth. Bark brown, fibrous, peeling off in strips, sometimes twisted. Wood rather soft without bast rings, with many very large pores with distinct walls, sometimes divided, med. rays inconspicuous. Near the pith are sometimes patches of tissue with red juice, but the outer bark has no red juice. Wings of corolla ·5″ long, falcately oblong with spur above base, obtuse; keel petals free, long-clawed, spurred. Ovary silky, about 10-ovuled, style puberulous. Vexillary stamen rarely slightly connate. Young pod densely brown bearded on the sutures and densely appressed hairy on the faces.

The tubers sometimes attain an enormous size. *Campbell* mentions one from the Gobindpur sub-division nearly 2 ft. long and 2·5 ft. in circumference. They are sometimes cut up, boiled and eaten in Palamau, but their use as food seems to be far from general. In most districts they are used medicinally. *Campbell* states in Manbhum for renal complaints and to kill fish. In some districts eaten in particular conditions of the bowels, in other districts no use appears to be made of them.

2. **P. phaseoloides,** *Benth.* Syn. Dolichos phaseoloides, *Roxb.*

Rather a strong twiner but not at all woody. Stems with reflexed hairs, leaflets 3–4″ closely appressed-hairy beneath, less so above. Fls. ·5″ long blue (yellow according to an Indian collector) in axillary racemes 3–6″ long or about as long as the leaves, rhachis strigosely hairy. Pods numerous straight linear 2–3″ by ·15″ only, somewhat compressed, clothed with stiff adpressed hairs, 10–14-seeded.

Jungles of northern Purneah! Fl. Sept. Fr. Oct.–Dec. Perennial.

Terminal leaflet broadly rhomboid sometimes as broad as long rarely 5″, obtuse or acute, sometimes shallowly lobed, sec. n. 6, of which 1 basal. Petiole densely hairy, 1–1·5″. Stipules basifixed triangular, ·15″ long. Stipellæ subulate. Racemes sometimes 2-nate. Pedicels very short, recurved in fruit, so that the pods are strongly reflexed.* Seeds black, oblong, subterete, rough, not shining, with very hard testa and short hilum.

The pods and seeds are more those of a *Phaseolus* than a *Pueraria*.

47. MUCUNA, *Adans.*

Twining shrubs or herbs with pinnately 3-foliolate minutely stipellate leaves. Flowers usually large and usually purple (in our area), mostly fascicled on the tumid nodes of racemes which are axillary or lateral on the old branches or stems. Calyx widely campanulate, anterior lobe longest, upper two connate. Corolla much exserted, petals very unequal, the standard being much shorter than the wings which again are shorter than or equal to the keel, standard auricled at the base. Stamens dimorphous, the longer with basifixed anthers, the shorter with ovate dorsifixed bearded anthers. Ovary and style densely hairy. Ovules 2–many. Pod usually covered with fine irritating pungent bristles. Seeds transversely oblong with short hilum or orbicular with linear hilum.

I. Flowers 1″ or more long.
  A. Pod oblong with plaited faces.
    Lflts. lanceolate. Pod oblong, winged down the sutures . 1. *imbricata.*
    Lflts. ovate, Pod elliptic or rhomboid, 2–2·5″ . . . 2. *monosperma.*
  B. Pod linear, faces not plaited.
    1. Leaves silky beneath. Fls. purple.
      Pod grey with close bristles . . . . 3. *prurita.*
      Pod black with velvety persistent tomentum . . . var. *utilis.*
    2. Leaves glabrescent.
      Fls. white. Pod as in last variety . . . . . var. *nivea.*
      Fls. few, purple. Pod velvety, glabrescent . . . var. *capitata.*
II. Flowers about ·8″ or less . . . . 4. *minima.*

* In our specimens, but sometimes the pods are erect. In the closely allied genus *Phaseolus* the position of the pods has sometimes been used to differentiate species!

1. **M. imbricata,** *DC.* Marang atkir, itikar or etka, *K.*, *S.*

A large climber with slender sparsely hairy or yellow-setose branches, lanceolate or ovate-lanceolate or elliptic usually acuminate leaflets 4–6″ long sparsely shortly yellow hairy beneath, dull purple flowers in pendulous long peduncled racemes 4–6″ long and pods about 5″ by 2″, easily recognised by the two wings on each suture and the obliquely plaited faces. Seeds 2–4, large, flat, with a circumferential hilum.

In the damper forests, N. Champaran! Ravines in Singbhum and Santal Parganas! Parasnath (Hazaribagh)! Angul! Fl. Aug.–Oct. Fr. Dec.–Feb., but pods remain long on the plant and were found on Parasnath in May.

Petiole and leaf-rhachis slender, together about 3–5″ long. Petiolules stouter, ·25″. Stipellæ minute, setaceous. Peduncles usually 6–12″ long. Flowers about 8–10, 2–2·25″ long. Bristles on the plaits ferruginous and style persistent as a hard slender beak.

2. **M. monosperma**, *DC.* Sarni, Bai-donka, *Or.*

A large climber with sometimes worted glabrescent branches, ovate broadly ovate or (terminal) sometimes elliptic leaflets, very dark green with red nerves and scanty ferruginous hairs, mostly about 4″ long and shortly suddenly cuspidate. Fls. large purple in short-peduncled short racemes about 3–4″ long only. Pods sub-globose when young, afterwards ovoid or ellipsoid or rhomboid, 2·5″ long, 1-seeded.

Damp forests. Mals of Orissa! Fl. Nov.–Dec. Fr. Feb.–April.

Petiole and leaf-rhachis together 4–6″ long. Stipellæ minute, setaceous. Peduncles usually about 1″ only and racemes few-flowered. Flowers about 2″ long. Pod very bristly when young with slender hardened style-base. The young pod is not winged on the sutures, but some specimens at Kew show the wings in old pods.

3. **M. prurita,** *Hook.* Syn. M. pruriens, *F.B.I.* (not of *DC.*, teste *Gamble*); Kivach, *H.*, whence the English name Cowage; Alkusi, Atkir, Etka, *K.*, *S.*; Bai Khujani, *Or.*

A slender climber, leaflets appressed hairy beneath, lateral exceeding the terminal semi-cordate-ovate 3–6″ long with 6–7 rather strong lateral nerves, terminal rhomboid. Flowers purple, 1·25–1·5″ long in rather dense drooping short-peduncled racemes 6–12″ long. Pod turgid linear with the ends curved in opposite directions, 2–4″ long, densely clothed with brown or grey intensely irritating bristles. Seeds about 6 in a papery endocarp, black and shining.

In dry jungles, very common along riverain forests, throughout the whole area. Fl. Sept.–Nov. Fr. Jan.–April.

Stems sulcate and densely clothed with rigid hairs or with few appressed hairs. Petiole sometimes 10″ long.

Various medicinal virtues are ascribed to the plant, some probably imaginary. *Campbell* states that the root is given for delirium in fever and that a paste made from the powdered root is applied for dropsy. The hairs of the pod are anthelmintic and were at one time included in the *British Pharmacopœia*. Both the root and seeds are included in the Hindu *Materia Medica*. An intoxicating liquor, "khasuna," is prepared from the plant in Palamau. The young pods are eaten as a vegetable after removal of the hairs.

The following are possibly only cultivated varieties of *M. prurita*; they do not occur wild in our area:

α. **M. utilis,** *Wall.* Alkushi, *Beng.*; Kursar, *Mal Pah.*

It scarcely differs from *M. prurita* except in the black velvety pod. "In badly grown plants the racemes are often short and few-fld.
Cultivated in Chota Nagpur," *Prain.*

β. **M. nivea,** *DC.* Khamach, *Beng.*

It differs in the leaflets being glabrescent beneath and in the white flowers.
Cultivated in Chota Nagpur, *Wood.*

γ. **M. capitata,** *W. & A.* Kursar, *Mal Pah.*; Kuswa, *Kharw.*

Branches glabrescent. Lflts. usually smaller than in *prurita*, 2·5–4″ long, thinly appressed hairy beneath, sub-equal, petiole often shorter than the leaflet. Racemes in short peduncled few-flowered. Pod purple 5-6″, bristles at first dense subsequently few and deep brown or blackish, when dry marked with faint oblique grooves.
Palamau! Rajmahal Hills!
As the pod may sometimes be described as black and velvety, this may be the same as *utilis.*

4. **M. minima,** *Haines* (*Jour. As. Soc.*, xv, 7).

A very slender climber with sulcate thinly hairy stems, leaves with the petiole only 2–3″ long, terminal leaflet broadly elliptic or obovate 1–1·5″, lateral leaflets exceeding the terminal, very gibbous. Flowers only ·75–·8″ long in a few-flowered axillary cluster. Pod not seen.

Forest near Larasara, Sambalpur!
Fl. February.
Leaflets sericeous beneath and less so above, apex rounded, sec. n. 3-4. Petiole 1–1·5″. Stipellæ filiform. Pedicels ·15″. Calyx ·35″–·4″ densely sericeous, lowest tooth lanceolate about as long as the tube. Keel ·75″. Standard ·5″, nearly glabrous, wings slightly shorter than the keel, narrow. Upper part of filament of stamens with dorsifixed anthers dilated, free part of posterior filaments very long. Ovary linear and style densely hairy. Ovary 2-ovuled.

48. ERYTHRINA, *L.*

Trees with prickly branches or (*E. resupinata*) an undershrub with pinnately 3-foliolate leaves and gland-like stipellæ. Fls. red, showy, with spathaceous or two-lipped calyx and very unequal petals, the standard much exserted and exceeding the wings and keel. Upper stamen nearly free or connate with the others half-way up. Ovary stipitate many-ovuled. Pod linear turgid, septate usually more or less torulose.

I. Trees.
  A. Calyx oblique spathaceous and splitting.
    Calyx split to base, tip 5-toothed . . . . 1. *indica.*
    Calyx split half-way down, apex entire . . . . . 2. *stricta.*
  B. Calyx not spathaceous but two lipped.
    Lflts. broadly ovate or rhomboid . . . . 3. *suberosa.*
    Lflts. elliptic, much longer than broad . . . . . 4. *ovalifolia.*
II. Undershrub. Calyx 2-lipped . . . . 5. *resupinata.*

1. **E. indica,** *Lamk.* Marar, *S.*; Pharar, *Kharw.*; Palita-mundar, *Beng.*; Hadbad, *Ghatw.*; Pharad, Pangra, *H.*; Indian Coral Tree.

A prickly tree with the prickles small and black. Shoots at first densely tomentose but leaves quickly glabrescent, leaflets 3–6″,

broadly deltoid or base of terminal sometimes rounded or sub-rhomboid. Racemes very elongate usually 6″ excluding the peduncle which is about 4″ long. Flowers brilliant scarlet. Calyx split spathaceous with very oblique mouth, persistent and ultimately recurved, 5-toothed at the narrow tip. Pods many, 6–10″ long, beaked, somewhat curved, narrowed into a seedless base and a stout stipes ·75–1″ long, torulose, 6–12-seeded, somewhat stellate-pubescent.

Often planted. Rare in Purneah, *Ham.*; Ranchi! Palamau! Khandpara and Banki! Common in Khurda, where it is perhaps wild! Fl. March–April. Fr. April–July. Deciduous up to the time of flowering.

Bark smooth and greenish after the papery exfoliations, branchlets less stout than in the next. Stipellæ short swollen reflexed finally hard, sec. n. 4–5, of which one from the base. Standard about four times as long as the wings. Fruiting pedicels stout about ·6″. Seeds ·6–·7″ dark purple.

The wood is little used but *Gamble* says it is fairly durable although light and soft. "Wt. about 19 lbs. only." The bark is used as a collyrium in ophthalmia. The tree is very ornamental and grows easily from cuttings and is used in some parts of India for supporting the Black Pepper (*Roxb.*).

2. **E. stricta**, *Roxb.*

A large or mod.-sized tree with the stout branchlets very closely beset with sharp yellow prickles ·15–·2″ long. Lflts. hairy beneath when young, glabrescent, 3–6″ long and broad, broadly deltoid, base often rhomboid or rounded. Racemes under 3″ long on peduncles the same length. Flowers crimson, 1·8–2″ long. Calyx split, spathaceous, pubescent ·4″, not toothed at the tip. Pod not at all torulose (in our specimens), slightly curved, 4–6·5″ long by ·7″ wide, with a slender stipes ·5–1·3″ long and persistent spathaceous calyx; often beaked with the slender style. Seeds ·4–·5″, oblong.

Orissa. Chandka, Puri, *Gamble*! Sometimes planted! Fl. Jan.–Feb. Deciduous up to the time of flowering.

A much larger tree than the last. Bark pale smooth greenish after the papery exfoliations as in the last. Standard about ·4″ wide but if unfolded ·75″ wide and lanceolate.

3. **E. suberosa**, *Roxb.* (inc. E. sublobata, *Roxb.*). Piri, *K.*; Buru Marar, *S.*; Pharar, *Kharw.*; Paldua, Chaldua, *Or.*; Baldia, *Gond.*

A small very prickly tree with thick corky bark and leaves covered with white-brown tomentum beneath (exc. var. *glabrescens*). Fls. scarlet in sub-capitate racemes. Calyx persistent turbinate 2-lipped. Pod scarcely torulose (torulose *F.B.I.*), much as in *E. stricta*, narrowly spindle-shaped, 4–6″ long including the slender stipes, about ·4″ wide in the middle. Seeds 2–3 only.

In hilly districts throughout the province! Fl. March–May. Fr. April–June. Leafless up to June.

Rarely attains 5 ft. girth. Bark deeply furrowed, blaze thick yellowish. Prickles usually straw-coloured. Shoots densely tomentose. Terminal leaflet 6–9″ broad, not as long, base usually rhomboid or sub-cuneate, sec. n. 5–6, one from base. Petiole 6–7″ tomentose. Racemes 1·5–3″ long (excluding the peduncle). Standard 3–4-times as long as broad and twice the keel.

Var. **sublobata**, *Roxb.* Leaflets lobed or lobulate, very tomentose beneath. Monghyr! Hazaribagh! Parasnath!

Var. **glabrescens**. Lflts. almost glabrescent beneath. It may be distinguished from *E. stricta* by the areoles (between the reticulations) less conspicuous and not white. Champaran Hills!

The bark yields a good cordage fibre of a pale straw colour. The wood, ash, and bark are used for dyeing, and the bark is also used in medicine.

4. **E. ovalifolia,** *Roxb.* Hari-kekra, *Beng.*

A mod.-sized much branched tree with scattered pale-coloured prickles which often extend even on to the leaves and leaflets. Easily recognised, distinguished from any of the preceding by the elliptic or ovate-elliptic leaflets. Flowers crimson, mostly 3-nate on the rhachis of the raceme. Calyx pubescent, often irregularly splitting. Standard twice the keel, broadly obcordate with a long claw. Pod about 6″, torulose at least on one side, 6–8-seeded.

Puri! Perhaps only planted. Fl. Feb. also May. I have seen new shoots in September but it probably renews its leaves also at the end of the hot season like the others.

Bark pale brown thick and fluted or somewhat cracked. Prickles sometimes with black tips, very sharp and more slender than in the others. Lflts. 4–6″ long, rounded at tip, very pale beneath and minutely reticulate, glabrescent, sec. n. 6–8 of which one from base.

5. **E. resupinata,** *Roxb.*

An undershrub with shoots a few inches high, dying down annually, leaflets about 2·5″ long and broad, roundish or terminal rhomboid, lateral smaller, sometimes ovate or ovate-lanceolate, obtuse, tomentose or pubescent beneath, glabrescent? Petioles and nerves usually somewhat prickly. Racemes about 4–6″, short-peduncled, often appearing before the leaves. Fls. bright scarlet. Calyx 2-lipped. Standard elliptic far exceeding the small obovate nearly colourless wings. Pod not seen.

Higher plateau of Chota Nagpur. Neterhat, 3000 ft.! Parasnath! Fl. March-April. It occurs in Oudh and will very likely occur in Champaran.

49. PHASEOLUS, *L.*

Prostrate, sub-erect or twining herbs with 3-foliolate stipellate leaves and conspicuous stipules sometimes peltately attached. Fls. fascicled on the swollen nodes of axillary racemes. Calyx campanulate with the two upper teeth connate or not. Keel of corolla spirally beaked. Stamens 9 + 1. Ovary sessile, many-ovuled, style twisted with the keel, conspicuously bearded on the inner face (or, owing to torsion, on the side) below the very oblique stigma. Pod linear, rarely oblong, sub-terete or compressed, with usually thin septa between the seeds.

I. Stipules not produced at their base. Fls. rarely yellow.
  Pod over ·3″ broad, curved, 2–4-seeded.
  A. Pod oblong. Fls. whitish or yellowish green . . . 1. *lunatus.*
  B. Pod linear. Fls. medium-sized.
    Bracteoles large, exceeding the calyx. Fls. lilac to white . 2. *vulgaris.*
    Bracteoles shorter than the calyx. Fls. scarlet, rarely pinkish . . . . 3. *multiflora.*
II. Stipules produced below the base (peltate). Fls. yellow.
  Pod under ·3″ broad.
  A. Pods glabrous or puberulous, terete or sub-compressed, straight.
    1. Pods terete, seeds rounded at ends.
      Stipules oblong. Lflts. shortly lobed . . . . 4. *trilobus.*
      Stipules lanceolate. Lflts. deeply lobed . . . . 5. *aconitifolius.*
    2. Pods sub-compressed. Seeds truncate at the ends.
      Lflts. usually repand, scarcely lobed . . . . . 6. *calcaratus.*

B. Pods hirsute, sub-compressed.
  1. Wild. Stems twining and pods distinctly septate . . 7. *sublobatus.*
  2. Cultivated. Stems sub-erect or shortly twining. Pods sometimes not septate. Septa sometimes evanescent.
    a. Pods erect or sub-erect (*mungo*).
      Sub-scandent, seeds black . . . . 8. *mungo.*
      Diffuse. Seeds black with grey spots . . . . (9.) *Roxburghii.*
    b. Pods spreading or reflexed (*radiatus*).
      Seeds green, pods patent . . . . . . 10. *radiatus.*
      Seeds yellow, pods reflexed . . . . . . (11.) *aurea.*
      Seeds black, pods patent . . . . . . (12.) *grandis.*

NOTE.—The above key is mainly after *Prain* in *Bengal Plants*, but he defines two species, viz. *mungo* and *radiatus*, and treats the others (shown in brackets) as varieties of these two. I look upon all of the species 8–12 as varieties derived from *sublobatus*. The position of the pod is not a satisfactory character. *Gamble* (*Madras Flora*) adds "seeds black" in the definition of *P. mungo* and "seeds green" in that of *P. radiatus*. This would reduce *P. grandis* to a variety of *mungo*, whereas *Prain* considers it a variety of *radiatus*!

Baker in *F.B.I.* reduces *P. radiatus* to a variety of *P. mungo.*

1. **P. lunatus,** *L.* Rangoon Bean, Sugar or Lima Bean.

Twining with pubescent but often glabrescent stems. Lflts. 2–4″ long, nearly glabrous, terminal tapering-rhomboid. Racemes usually short, 1–3·5″, hairy. Fls. hairy, ·17–·25″, usually 3 to a node. Pod 2–2·5″ long by ·6–·7″ broad, somewhat curved, shortly beaked, glabrous, seeds 2–4 large, usually white, sometimes purple.

Occasionally cultivated, chiefly in Orissa. Fl. Aug.

It is said to be injurious to cattle, owing to prussic acid, which, however, is dissipated in cooking.

2. **P. vulgaris,** *L.* French Bean, Haricot Bean.

Glabrous or nearly so, twining or low and suberect (var. *nanus*). Lflts. thinly hairy, terminal rhomboid with rounded sides and slightly tapering tip, 2·5–3·5″ long. Racemes 1·5–7″, axillary very lax. Fls. pale-coloured, slender-pedicelled, in pairs on the not much thickened nodes, easily recognised by the very conspicuous large nerved bracteoles embracing the flower and exceeding the calyx, ultimately spreading, ·3″ long. Pods about 3–5″ by ·4″, beaked.

Often cultivated in European gardens.

Roxburgh says the bracts (bracteoles) are shorter than the calyx, evidently following *Willdenough*, who made this mistake.

3. **P. multiflorus,** *Willd.* The Scarlet Runner.

Stem twining. Flowers geminate, scarlet, in many-flowered racemes as long as the leaves, the two bracteoles appressed to and shorter than the calyx. Pods long pendulous.

Occasional in European gardens. A native of Mexico.

4. **P. trilobus,** *Ait.* Mugani, Rakhal-kalai, *H.*

Stems trailing 1–2 ft. long, glabrous or hairy. Lflts. very variable in size usually shorter than their petioles, nearly always lobed, lobes usually three shallow and rounded, in the wild plant sometimes deeply lobed, but lobes broad obtuse or rounded and sub-spathulate. Stipules oblong or ovate-oblong, very large, ·3–·5″, attached above their base. Stipellæ small, but spreading and foliaceous. Racemes capitate or spiciform, long-peduncled. Fls. about ·2–·25″ long.

Bracteoles ovate. Pods narrowly linear about 2″ long, only about ·1–·12″ broad, glabrous, sometimes curved. Seeds 6–12, grey, small oblong with rounded ends, lineolate.

Apparently wild. Behar, *Hope*! Manbhum! Puri, *Hooper*! Fls. chiefly r.s. The seeds are gathered and eaten by the poor. Cattle eat the plant.

5. **P. aconitifolius,** *Jacq.* Moth, *H.*; Bir-moch, *S.*; Mung, *K.*

Stems numerous, trailing for several feet, often very hairy. Lflts. always deeply lobed and the lobes often again lobed, lobes linear or lanceolate and acute, somewhat hairy. Petioles longer than the leaflets. Stipules sharply lanceolate, ·2″ rarely ·3″, and stipellæ linear or subulate. Racemes usually capitate, flowers ·2″ or less, but standard ·25″ broad. Bracteoles linear-setaceous, far exceeding the minute calyx. Pods 1–2″ long, ·15–·17″ broad. Seeds often 7–8.

Doubtfully wild, often cultivated. *Campbell* says that it is wild in dry situations in Manbhum, and the Santal name supports this. Santal Parganas, *Wood*! Cultivated in Ranchi, Singbhum, etc.! Fl. chiefly Sept.-Oct. Fr. Oct.-Nov.
The grain is eaten and the plant used for fodder.

6. **P. calcaratus,** *Roxb.* Sutri, *H.*; Bir Mung, *S.*

A slender twiner. Stems with spreading hairs. Leaves long-petioled. Lflts. 2–4″, terminal rhomboid-ovate repandly 2-lobed or wavy each side, rarely some lanceolate and entire, both sides hairy. Stipules large peltately oblong, ·4–·5″, hairy and ciliate, 12-nerved above. Racemes ·25″ elongating to 1″ with peduncle 1–3″. Pod never with long hairs, hirtellous or puberulous.

Wild in Sal forests in Singbhum! Abundant in a wild state in high dry jungle lands. Manbhum, *Campbell*! Lohardaga, *Clarke*! Palamau forests! Koderma forest! Santal Parganas, *Kurz*, *Wood*!
Fl. Aug.-Sept. Fr. Sept.-Nov.
Lflts. often softly hairy both sides, broad-ovate or rhomboid or upper quite narrow, always some wavy or lobulate, larger 4″ by 3″ rarely up to 5″. Peduncles 2–4″. Fls. yellow, ·32″ broad. Bracteoles setaceous. Pod 1·75″, 9–12-seeded, seeds brown, not shining, small ·08″ or less, truncate both ends.
The seeds are eaten.
Very closely allied to *P. sublobatus*, but probably distinct, the very small short appressed hairs on the pods very constant in character. But it is doubtfully *Roxburgh's* plant which has quite glabrous pods. *Roxburgh* states that the *carina* has a remarkable long horn on the right side (when looking at the back of the keel). My specimens are unfortunately not in a state to determine this.

7. **P. sublobatus,** *Roxb.* Ghora Mung, *Beng.*

A twiner with branches and petioles brown-hairy, 3-foliolate leaves with leaflets sparsely setosely hairy on nerves beneath and rather more so and also hispidulous above, terminal mostly ovate lanceolate with a rounded lobe each side, lateral often sub-lobed. Racemes often on leafless slender branches. Fls. capitate sub-sessile or pedicelled. Pods spreading terete (or compressed in *Herb.*) with rather rigid ascending hairs, about 12-seeded. Seeds terete ·1–·12″ dark grey with longitudinal wavy lineoles. Stipules large oblong ·2–·45″.

Wild in the forests. Palamau ascending to 3000 ft.! Ranchi! Parasnath, 4000 ft. *Clarke*! Fl. Sept. Fr. Oct.-Nov. Annual.
Var. *α* **typica.** Very slender. Lflts. 2–3″. Petiole 1·25–1·75″. Stipules ·2–·3″ sparsely ciliate. Stipellæ ·2″ setaceous exceeding the petiolule. Peduncles ·4–·7″

strigosely hairy. Racemes ·2″ few-fld. Bracts oblong-lanceolate. Pods 1-3″ thinly septate. Neterhat 2500-3000 ft.! Parasnath!

Var. β **robusta.** Stouter and more densely hairy. Lflts. 3-4″. Petiole 1·5-2″. Stipules ·3-·45″ strongly 8-nerved and strongly ciliate. Racemes up to ·8″. Peduncles 3-6″. Pods 1·5-2″ by ·18″. Palamau and Ranchi forests!

This last comes very close to the cultivated *P. radiatus*, *L.*, esp. var. *grandis*, which, however, has got perfectly smooth seeds.

8. **P. mungo,** *L.* Urid, mashkalai, tikari-kalai, *Vern.*; Ramra, *Kol.*

A cultivated diffuse or shortly scandent herb with often twisted stems with spreading or reflexed hairs sometimes glabrescent. Lflts. ovate lanceolate or ovate sometimes slightly lobed. Stipules 6-12-nerved ·3-·5″ oblong, often hairy and sometimes ciliate. Pod 1-1·3″ rarely more, erect or ascending, hairy. Seeds 4-6 black or black mottled grey, smooth.

Chota Nagpur, commonly cultivated! Santal Parg., *Kurz*! Probably throughout the province. A cold weather crop.

Both this and *P. radiatus*, *L* are probably cultivated forms of the indigenous *P. sublobatus*. The flowers are a purer yellow than in *P. radiatus*.

(9.) Var. **Roxburgii,** *Prain* Syn. P. radiatus, *Roxb.* (in *F.I.*); Mash Kalai, *Beng.* is the suberect or diffuse form with seeds (f. *Prain*) grey only. I am inclined to think the colour rather variable. I have seen brown seeds in forms with erect pods. Indeed all the characters seem very variable.

Roxburgh describes it as diffuse and hairy. Lflts. elliptic. Stipules lanceolate. Horn of the keel very long. Pods straight hairy terete nearly erect 2″ long, very hairy. Seeds small, 4-6, black with grey spots.

He states that it is the most esteemed of all the Leguminæ. Cattle eat the straw of this variety and it is considered very nourishing.

10. **P. radiatus,** *L.* Syn. P. Mungo var. radiatus, *F.B.I.*; Mung, *H.*, *Beng.*

A cultivated plant rarely more than a foot high. Stems with spreading hairs or hairs somewhat reflexed. Lflts. sparsely setosely hairy, variable in size according to cultivation, usually 1-3″. Stipules ·3″, 5-7-nerved usually ciliate. Racemes under ·5″ usually ·3″ but occasionally sub-panicled. Pods 1·5-2·5″ by ·2-·22″ spreading or reflexed, hairy when young with hairs inclined forwards but usually glabrescent. Seeds smooth.

Cult. apparently throughout the province.

Var. α **typica** (*P. mungo*, *Roxb.*). "Pods spreading, seeds green," *Prain.* Balasore! Burdwan! A common field crop.

(11.) Var. β **aurea** (*P. aureus*, *Roxb.*). "Pods reflexed, seeds yellow," *Prain.*

(12.) Var. γ **grandis** (*P. Max*, *Roxb.*). Krishna Mung, *Beng.*; Mash Kalai; Urid, *H.* "Pods longer, spreading. Seeds black," *Prain.*

This last is very close to *P. sublobatus* var. *robusta* (*q v.*), but the wild plant is a good climber and seeds not so smooth. One specimen has the leaflets somewhat lobed. *Baker* is probably more logical in reducing *P. radiatus* to a variety of *P. mungo* (*q.v.*)

50. VIGNA, *Savi.*

A genus only separable from *Phaseolus* by the keel petals, which are not spirally twisted, though often incurved.

Even this character often fails in *V. vexillata*, which I only retain in *Vigna* instead of *Phaseolus* for uniformity with other floras.

The stigma is sometimes large and capitate, situated on the inner face and with the minute horn-like appendage often more dorsal than in *Phaseolus*.

I. Keel with an incurved beak. Pods hairy, at least when young.
  Standard 1·25″ diam. Pod with short brown hairs . . . 1. *vexillata.*
  Standard 8″ diam. Pod densely pubescent and hairy . . 2. *pilosa.*
II. Keel scarcely beaked. Pod glabrous.
  Cultivated, twining or sub-erect . . . . 3. *catjang.*

1. **V. vexillata,** *Benth.* Syn. Phaseolus vexillatus, *L.*; Serwang, Bir Ghangra, *S.*

A slender twiner with tuberous roots and scabrid stems. Lflts. narrowly lanceolate, rarely ovate-lanceolate, usually about 6·5″ by 1·75″, often flushed white near the mid-rib, scabrellous above and on the ribs beneath, base rounded. Fls. large pale-purple in few-fld. heads on very long peduncles, vertically compressed with keel sometimes spirally curved. Pods narrowly linear straight, 3–4″ long by ·2″ broad, with sparse short brown hairs, 15–20-seeded.

Frequent in the forests of Chota Nagpur, edges of fire-lines, etc. Singbhum, cheifly on the Porahat ghats! Hazaribagh! Ranchi! Manbhum, *Camp.*! Fl. July–Oct.

Petiole 2–3″ long. Peduncles 6–9″ long, the raceme very short and often only 2–3-flowered with very short pedicels. Pod glabrescent.

The roots as well as the beans are eaten by the Kols and Santals.

2. **V. pilosa,** *Baker.* Syn. Dolichos pilosus, *Roxb.*

A twiner with hairy stems. Terminal leaflet lanceolate acuminate about 7″ by 3″, shortly hairy both sides, base 3-nerved; lateral rather shorter sub-falcate with very oblique base. Peduncles not longer than the 1″–1·75″ long raceme. Flowers pale purple ·7″ long with standard ·8″ broad. Pod 4–5·5″ long, slightly compressed, nearly straight, about ·3″ wide, beaked, densely pubescent and hairy, about 10–12-seeded. Seeds oblong, shining black ·2″ long.

Singbhum, Songra forest, near streams! Fl. Oct.–Nov. Fr. March. Perennial.

Hairs appressed or in young parts spreading and of two lengths. Stipules narrowly lanceolate basifixed ·15″. Petioles of larger leaves 3–3·5″ long much thickened below, pubescent, 2-margined above. Lflts. paler beneath. Calyx-tube ·17″ slightly gibbous covered with small appressed brown hairs, lower tooth lanceolate as long as tube, upper lip extremely short, notched. Wings with very slender claw and basal spur as well as a short hooked spur below the rounded apex, keel with an incurved not at all spiral beak. Pedicels ·1″.

3. **V. catjang,** *Endl.* Syn. Dolichos Catiang and D. sinensis, *L.*; Barbati, *Beng.*; Badbadi, *Kharw.*; Lobia, Ransi, *H.*; Ghangra, *S.*; Rambara, *M.*; Galjaramba, *Ho.*; Bodi, Rewas, *Uran.*

Erect with long trailing branches or twining. Stems striate hispidulous or glabrous. Terminal leaflet rhomboid 2·75″ and nearly as broad, nearly glabrous or attaining 5″ and sub-hastately 3-lobed and lanceolate, the side lobes, if present, very rounded, base always very obtuse, glabrous and rather shining beneath and faintly puberulous above; lateral leaflets about as long as terminal, very unequal-sided. Flowers mostly geminate at the nodes, nearly 1″, pale-yellow with purple wings or tinged purple, in the twining form often quite 1″ with pale blue and white corolla. Standard ·75–1″

diam. sub-orbicular with 2 ridges and 2 small callosities above the claw. Keel carinate. Pod long linear sometimes 1–2 ft. and ·3″ broad with 15–23 seeds. Seeds usually white ·3″ subterete.

Cultivated in all the districts either with other crops or trained on trees and trellises or as a separate field crop.

Fl. chiefly Sept.–Nov. Fr. Oct.–Dec. or later.

Petiole 3–5″ long grooved and often sub-alate above, rhachis of terminal leaflet often over 1″, similar. Stipules ·5–·9″ long, oblong acuminate attached near the base but with a broad lanceolate often curved auricle, rarely (in the twiner) only ·3″ and spurred. Stipellæ small ovate or tumid or oblong. Peduncles striate shorter than or much longer than the petiole. Racemes very short ·5–1″ hispid. Calyx ·3″ long with campanulate tube about as long as the subequal narrow-lanceolate teeth, sometimes tuberculate or transversely rugose.

Var. **typica.** Pods erect about 5″, 6–12-seeded, expanded or sub-truncate at the tip, seedless both ends. Ramba, Bodi, *Vern.*

Var. **sinensis,** *Willd.* (sp.) Pods very long, 1–2 ft., pendulous, 15–23-seeded, torulose, usually twining. Galjaramba, *Ho.*, Daonbodi, *H.*

The whole pod is eaten cooked.

Pachyrhizus angulatus, *Rich.* (Syn. Dolichos bulbosus, *L.*; Sankalu, *Beng.*), is a robust climber which is fairly widely cultivated in the moister regions but has so far not been seen by me in our area though it is very probably cultivated in Orissa. The genus differs from *Pueraria* in the style being flattened upwards and being bearded within below the stigma, and from *Phaseolus* in the keel not being at all spiral. The plant has large tuberous roots which are eaten, sharply angled or very acutely sub-lobed leaflets, and long racemes of handsome blue flowers. The pod is compressed about 5–10″ long, much depressed between the 8–12 round flattened seeds. *Roxburgh* says it is cultivated throughout the Malay Islands for its roots, which resemble a turnip in taste.

52. DOLICHOS, *L.*

Twining, more rarely sub-erect, herbs with stipellate 3-foliolate leaves and small sub-persistent bracts, bracteoles and stipules. Fls. small or m.s., axillary or racemed, much as in *Vigna*, but the incurved keel not at all twisted and stigma terminal without a dorsal process. In many species, too, the style is hairy all round the stigma instead of being bearded on the inner face. Pod flat, linear or oblong or sub-oblong and wider in middle or upwards, curved, usually tipped with the style. Seeds not or somewhat flattened, sometimes with a thickened and sub-persistent funicle.

Style thickened upwards, bearded on the inner face . . . . . 1. *lablab.*
Style slender, hairy all round the stigma.
  Root tuberous. Flowers on a slender bracteate peduncle . . 2. *falcatus.*
  Root annual. Flowers 1–3 axillary . . . . 3. *biflorus.*

1. **D. lablab,** *L.* Inc. D. lignosus, *Roxb.*, not of *Linnæus*; Sim, Sirmi, *K.*; Malhan, Malal, *S.*; Shim, *Beng.*

A rather powerful climber, or in some forms dwarf and sub-erect with sarmentose branches. Lflts. pubescent both sides, but especially on the nerves beneath, terminal 2–4″, rarely 6″, long and broad, broadly ovate or deltoid, shortly acuminate, base strongly 3- or 5-nerved. Flowers red, purple or white in racemes which are axillary 3–6″ long or terminal and attaining 9″ excluding the peduncle. Nodes tumid with 1–4 flowers ·75″ long. Calyx campanulate, ·25″, subequally toothed, standard ·6–·75″ broad, keel rostrate. St. diadelphous. Style bearded down the inner face. Pod white to purple and usually shining, sub-lunate-oblong or wider above the middle,

2–3″ long, tipped with the sharply bent style. Seeds with their axis at right angles to sutures about ·5″ long, rarely (in variety) with long axis parallel to suture, and then pod loses its normal shape and is longer. The sutures have a characteristic crisped or crenulate appearance.

Cultivated in all districts and one of the commonest climbers near the houses of the natives. The dwarf variety is less cultivated than in the Central Provinces. Fl. Oct.–Jan. Fr. c.s.

Stems pubescent or puberulous. Petioles 2–6″. Stipules lanceolate ·15–·2″ long. Stipellæ variable in shape usually as long as the petiolule. Pedicels under ·1″. Bracteoles appressed to calyx, oblong, ciliate, ·06″.

Var. **lignosus**, *Roxb. sp.*, has longer linear-oblong pods less curved (see above). The racemes long and erect. It is the form usually grown as a dwarf and kept for the seeds, which are eaten.

In the usual short-podded form the bean is usually eaten before the seeds ripen.

2. **D. falcatus,** *Klein.* D. falcatus, *Willd.* (*F.I.*).

A slender climber with rather small 3-foliolate leaves and simple and 3-lobed leaflets sometimes with a pale patch in the centre. Fls. yellow (or blue-purple, *Roxb.*), ·5″, in a very slender usually short lax few-fld. raceme or solitary on a slender bracteate peduncle. Pod pale, flat, curved, 2–3″ by ·4″, with 5–8 somewhat kidney-shaped seeds ·3″ long.

Hill forests of Puri! Fl. Fr. Nov.–Dec.

Root a fusiform tuber. Branches with fine spreading hairs. Lflts. 1–1·5″ or a few up to 2·3″ with few short fine adpressed hairs both sides. Peti. slender 1–2″. Stipules lanceolate ·1″ reflexed. Calyx ·17″. Funicle very broad.

Roxburgh's drawing marked *Dolichos trilobus* 289 (*Cal. Herb.*) is this.

3. **D. biflorus,** *L.* Hore, *M.*; Hoe, *Ho.*; Horec', *S.*; Kurti, Kulti, *H.*; Kulthia, *Or.*; The Horse-gram.

A sub-erect villous herb with sub-scandent branches or, in the wild form, twining and less hairy. Lflts. ·75–1·75″ long lanceolate to ovate-lanc. or ovate-oblong, hairy both sides and often reflexed. Fls. very pale yellow with a crimson spot on the standard, 1–4 together axillary, ·45″ long. Pod curved, very slightly so in the wild form, linear or broadly-linear, 1–1·7″ long, thinly appressed-villous or sub-glabrescent. Seeds 4–6, reniform, grey.

One of the commonest field-crops in Chota Nagpur and frequently cultivated also in all other districts. Fl. Sept.–Nov. Fr. Oct.–Dec.

This appears to be an indigenous plant in India but not perhaps in our area. The calyx-teeth are very long and setaceous, about three-fourths as long as the flower.

Easily grown and eaten largely by the aborigines but is inferior, and in the more cultivated districts is used chiefly for cattle food. The straw is also used as fodder.

The orbicular-cordate cotyledons are long persistent.

53. CLITORIA, *L.*

Twining herbs (in our area) with pinnately 3–7-foliolate leaves and persistent striate stipules. Flowers large showy, axillary or paired on the rhachis of axillary racemes. The genus differs from the allied genera in the standard far exceeding the wings and keel. Stamens diadelphous. Ovary stipitate. Style incurved, flattened, bearded along the inside below the capitate, not oblique stigma. Pod linear, flattened or turgid.

1. **C. ternatea,** *L.* Aparjita, *Beng.* The Mussel-shell Creeper.

A very beautiful slender twiner with pinnately- (mostly) 5-foliolate leaves, elliptic leaflets 1–2″ long and azure blue, more rarely pure white, flowers 1·5–2″ solitary on axillary peduncles with large foliaceous persistent bracteoles and the spoon-shaped standard expanding under the wings. Pod flat linear about 3·5″ long.

Very common in gardens and as an escape. Fl. chiefly in the r.s. Fr. Nov.–Dec.

54. DALBERGIA, *L.f.*

Trees or shrubs, sometimes scandent. Leaves pinnate with alternate exstipellate leaflets. Fls. rather small in axillary or terminal panicles. Corolla usually only shortly exserted, wings oblong as long as the broad standard, keel obtuse with the petals joined at the tip. Stamens 9 or 10 monadelphous or 5 + 5 diadelphous, rarely 9 + 1. Ovary stipitate, few-ovuled. Style short, stigma capitate. Pod thin flat, usually oblong and veined opposite the seeds, indehiscent. Seeds 1–4.

The pods usually remain long on the tree. The seeds germinate within it after the pericarp has become so softened by the first monsoon rains that the radicle can penetrate it.

Root suckers are very common in the genus.

I. St. monadelphous in a sheath split above, rarely the tenth stamen casually free
 A. Trees. Leaflets large roundish.
  Lflts. 3–5 cuspidate. Corolla yellowish . . . . 1. *sissoo.*
  Lflts. 5–7 obtuse or emarginate. Fls. white . . . . 2. *latifolia.*
 B. Shrubs, ultimately climbing. Fls. white.
  Lflts. 5, sec. n. 2–4. Fls. ·2–·25″ . . . . . . 3. *candenatensis.*
  Lflts. 5–7, sec. n. many. Fls. ·3″ . . . . . . 4. *rubiginosa.*
  Lflts. over 20 . . . . 5. *tamarindifolia.*
II. St. diadelphous 5 + 5, sheath split above and below.
 A. Climbing shrub. Lflts. 11–13. Fls. purplish ·25″ . . 6 *volubilis.*
 B. Erect trees.
  Lflts. ·5–1·5″. Fls. ·3″ standard oblong . . . . 7. *paniculata.*
  Lflts. ·75–2·5″. Fls. ·3–·5″ standard orbicular . . . 8. *lanceolaria.*
 C. Erect or climbing, thorny. Lflts. 7–9. Fls ·12″ . . . 9. *spinosa.*

1. **D. sissoo,** *Roxb.* Shisham, *H.*; Sissu, *Nep.*

A large handsome tree, lflts. 3–5 usually 5, broadly ell., ovate or obovate or orbicular, cuspidate or acuminate, 1–3″ long. Fls. small yellowish, sub-sessile, secund on the branches of dense, densely pubescent axillary panicles 2–3″ long. Stamens 9. Ovary long-stipitate pubescent with very short style. Pod strap-shaped with cuneate base 1–3″, 1–3- rarely 4-seeded.

Indigenous along rivers in Northern Champaran and the Mechi river in Northern Purneah, but the rest of the northern area seems just outside its natural distribution. It is however commonly planted throughout the province, especially in the northern districts! Fl. with the new leaves March–April. Pods ripen in the next c.s. and usually remain on the tree until it again flowers, and the seeds germinate in June–July. Partially deciduous Dec.–March.

Attains 6–12 ft. girth with grey or pale brown thick bark exfoliating in narrow longitudinal strips. Shoots pubescent. Corolla twice the calyx or less, standard orbicular long-clawed.

A beautiful timber and yielding one of the handsomest furniture woods. The transverse strength is very great. *Gamble* gives the value of P as 700–900. It forms

the best of wooden wheels and one of the best for all implements requiring strength and elasticity. "Its weight varies from 42-52 lbs." (*Gamble*). It grows very quickly when young. Planted trees in the compound of the manager of the Bettiah Raj actually showed a girth of 8 ft. in 20 years (if the age furnished by the manager was correct) and the average of seven 3-year-old *Sissoo* was 6″ girth per annum.* For sowing an absolutely clean seed-bed is required and thus natural reproduction only takes place as a rule in new river silt. It is an excellent fuel and makes a splendid charcoal but its light cover renders it a poor avenue tree. It requires a light soil.

2. **D. latifolia,** *Roxb.* Setisar, *Th.*; Kiri, *K.*; Satsayer, Mahle, *S.*; Pahari-Sissu, Sitsal, *H*; Blackwood, Rosewood.

Usually a small tree except in the south of our area. Leaves odd-pinnate with 5–7 very unequal-sized leaflets on the same rhachis, lflts. sub-orbicular with round or emarginate tip, glabrous 1–4″ long, petiolule ·25–·4″ long, pale beneath. Fls. pure white in very numerous lax panicles 2–4″ long axillary and from the leaf scars. Pods 1·5–3·5″ by ·75″ stipitate, 1–3- rarely 4-seeded.

Northern area, in the Sameshwar Hills! Not uncommon as a small tree especially on cool aspects in the Southern and Central area. Often a large tree in the Southern area. Fl. Sept. when the tree is in full leaf. Fr. Jan.–Feb.

Attains 7·5 ft. girth in the Jocobo Block, Angul! Over 3 ft. in the Rajmehal Hills! Bark light-coloured, blaze green then pale yellow. Pedicels and calyx ·12–·17″. Corolla twice as long. The pods sometimes constricted at the sutures between the seeds.

This is as valuable a wood as the true *Sissu*, indeed it appears to me to be a more handsome furniture wood and it is in as great demand for gun-carriages and other articles requiring great strength, but in our area it is too scarce to supply a large demand and it should be artificially propagated in Angul. *Gamble* gives the value of P as between 822 and 1052! and the weight as 50–70 lbs.

The reproduction under shade in the Baghmunda forest of Angul in good soil is excellent. The growth of trees raised by me from seed in Chaibassa was on an average of 32 ft in height and 18″ girth in 16 years, but the locality is entirely unfavourable.

3. **D. candenatensis,** *Prain.* Syn. D. monosperma, *Dalz.*; D. torta, *Grah.*

A climbing shrub frequently with very lenticellate branchlets spirally coiled round supports. Leaves small, leaflets usually 5 obovate rounded at tip or emarginate ·8–1-8″ long with sec. n. 2–4 only very fine scarcely distinguishable from the reticulate nervules. Fls. white ·2–·25″ long in short simple or branched racemes, ·7–1·5″ long axillary and on lateral abbreviated branchlets. St. 9–10 monadelphous. Ovary linear stipitate 1–2-ovuled. Pod flat, rather thick, sub-lunate, ·9 by ·4″, rarely 2-seeded and larger.

Tidal forests of the Mahanadi delta! Fl. May.

Leaf rhachis ·8–2″ Lflts. with sparse short adpressed hairs beneath; petiolules ·02–·1″. Rhachis of racemes rusty pubescent. Calyx green with short rounded or obtuse teeth. Petals with claws longer than the calyx. Standard ovate slightly auricled.

4. **D. rubiginosa,** *Roxb.* Kanchanai, *Or.*

A dwarf bushy or scandent shrub with rusty pubescent shoots, small odd-pinnate leaves with 5–7 ell. or oblong, somewhat obovate leaflets ·5–2·5″, and white or cream coloured flowers ·3″ in short

* Vide *Report on the Forests of Rajpur-Soherin*, 1904, by *H. H. Haines.*

axillary simple or panicled racemes ·5–1·5″ long. St. 10 monadelphous with sheath split above. Ovary linear long-stipitate 2–3-ovuled. Pod 1·3″ very thin, but opaque and venous.

Frequent in Angul! and Puri districts! often in rocky places when it becomes bushy. Fl. April–June. Fr. April–June.

L. rhachis with short petiole 1–2·5″ pubescent. Lflts. subsessile increasing in size from the base of the rhachis upwards, coriaceous polished above, finely sericeous partly or wholly glabrescent beneath, finely closely nerved, tip rounded rarely sub-acute. Rhachis of raceme densely rusty hirsute with 2 rows of minute sub-secund bracts. Fls. sometimes subsolitary usually close but not fascicled. Calyx ·12–·2″ campanulate rusty-pubescent, lobes oblong-rounded, two upper broader and shorter than the 3 lower. Standard retuse long-clawed and with two fleshy callosities. Wings oblong auricled. Keel petals connate above, all long-clawed. Filaments free above. Sheath open at base then connate anteriorly.

5. **D. tamarindifolia,** *Roxb.*

A large shrub scrambling or climbing by means of its recurved peduncles, singularly resembling a climbing Tamarind. Branchlets and leaf rhachis fulvous pubescent. L. 4–7″ with 12–20 prs. of oblong leaflets ·3–·8″ long, appressed fulvous-hairy beneath and less so or glabrescent above. Fls. white ·25″ in dense brown-pubescent shortly panicled racemes ·5–2″ long mostly from the leaf scars and on the new shoots. Pod linear oblong thin glabrous long-stipitate 1·5–3″ long.

Ravines in the northern Rajmahal Hills, S.P.! Mayurbhanj, near streams above 2500 ft! Fl. Feb.–March. Fr. April–May. Partially deciduous in Feb.

Lflts. sub-sessile with oblique base somewhat gibbous on the upper edge, apex rounded or retuse. Calyx ·12″, lobes obtuse, ovate. Pet. long-clawed. Ovules 2–3. Pod 1–3-seeded.

My specimens were not in flower.

6. **D. volubilis,** *Roxb.* Nari siris, *K.*, *S.*; Kalibeti, Nubari, *Or.*

A sarmentose and scandent shrub with long green branches, 7–13-foliolate leaves and pale purple or pale blue flowers in ample terminal panicles. Stamens in two bundles of 5 each. Pods oblong, 2–3·5″ long by ·6–·75″ broad, veined opposite the seed.

N. Champaran, common! Throughout the Central and Southern areas, along ravines and nalas! Fl. Feb.–March. Fr. May–June.

Attains 2 ft. girth in the Santal Parganas. Stem fluted. Wood with very large pores but without concentric bast rings. Leaves 3–10″ long. Lflts. broadly oblong or obovate attaining 3·25″ by 1·5″ but usually only ·75″–1·75″ on flowering branches, very obtuse or emarginate, apiculate, nearly glabrous, petiolule ·06″. Inflorescence appressed pubescent or rusty tomentose with lateral branches 3–5″ long. Fls. ·25–·3″ pedicelled dense. Calyx tube campanulate, upper two teeth sub-orbicular, lower narrower acute. Seeds 1–2 light brown, ·32″ ellipsoid slightly reniform.

7. **D. paniculata,** *Roxb.* Sojania-pati-tinia, Barahbakla, *Or.*; Dhobin, *Gond.*, *H.*; Sathpardia, *Gond.?*

A usually straight tall tree. Leaves with 7–15 alternate leaflets, ·5–1·5″ (rarely 1·75″), smaller orbicular or oval, larger oblong-elliptic or at end of rhachis somewhat obovate, beneath pale glaucous, minutely reticulate with somewhat raised nervules and nearly glabrous, above with sparse short appressed hairs. Fls. ·28–·3″

pinkish or bluish-white in dense very numerous mostly lateral panicles 2–3″ long. Standard oblong with claw about one-third its length not of different texture and not thickened above it, two small lateral auricles sometimes present at base of blade. Pods 2–3″ by ·5–·62″ tapering both ends, at base into a slender pedicel ·2–·5″ long. Seeds 1–3, brown smooth ellipsoid but sub-reniform at base.

In the Southern Tract only. Puri! Angul, common in cotton soil towards Khatada! Athmallik! Very common and grows to a large size in most of the Orissa States, *Cooper*! Fl. July with the leaves. Fr. Nov.–Jan.

Bark nearly white. Blaze as in next, from which it is sometimes difficult to distinguish in leaf. The tall straight habit is not invariable. The alternating bands of xylem and phloem serve to distinguish the stem and larger branches when cut. Lflts. with emarginate apex and usually rounded base, smaller than in the next. Calyx densely hairy, lower teeth subulate, upper linear-oblong sub-acute. The pod usually has a sharp terminal wedge with straight sides, whereas the terminal wedge in those of *D. lanceolaria* has often rounded sides and a blunt mucro.

The wood falls to pieces when sawn owing to the rings of phloem.

8. **D. lanceolaria,** *L.f.* Koiad, Kiachalom, *K.*; Chapot-siris, *S.*; Hardi, *Kharw.*; Lipsi (in Manbhum, teste *Grieve*); Chakundia, Sujanipati, *Or.*

A mod.-sized tree with leaves reaching a foot in length with 9–12 (or fewer on the smaller leaves) oblong, elliptic or obovate-oblong leaflets attaining 2·5″ by 1·5″ but often much smaller on the lower leaves of a branch, with about 12 very fine sec. n. and with thin scattered short hairs beneath, or on both surfaces when young. Fls. ·3–·5″ pink or purple or nearly white, sometimes tinged blue from a distance in dense or lax numerous lateral or terminal fulvous-pubescent panicles 2–4″ long. Upper calyx lobes rounded or obtuse. Standard sub-orbicular above and sharply geniculate on the hardened subulate claw, usually white-margined and with green central callus; two small auricles at the base. Pod 2–4″ by ·5–·75″, narrowed both ends, often sinuate between the 1–3 seeds with a stipes ·3–·5″ long.

Throughout the whole area, except perhaps in the north-east! Nowhere very common, usually in valleys or shady sides of hills and along streams. Fl. April–May when the tree is quite bare of leaves or with the young leaves. Fr. Sept.–Jan.

Bark white or grey nearly smooth, peeling off in oblong or irregular flakes. Blaze pale yellowish-white very soon darkening. Innovations yellow-silky. Stipules linear-oblong caducous. Lflts. with sometimes emarginate apex, base rounded, obtuse or sub-acute.

Var. *α* **lanceolaria** proper. Panicles and racemes lax. Fls. nearly ·5″. Calyx hairy with anterior lobe half to three-fourths the tube.

Var. *β*. Fls. secund in very dense racemes in panicles as dense as in last species. Fls. ·3″ only. Calyx densely hairy with anterior lobe as long as the tube. Santal Parganas!

A young forest of suckers springs up around this tree after the roots have been injured by trampling.

9. **D. spinosa,** *Roxb.*

A large woody climber or sub-erect, frequently with long sharp thorns bearing leaves and flowers, leaflets 5–9 usually 9, broadly elliptic or obovate ·4–·7″ long glabrous. Fls. very small in lax lateral racemes 1–1·5″ long rarely shortly panicled. St. diadelphous in two

sets of 5 each. Pod somewhat kidney-shaped ·8–1″ long, 1-seeded rarely 2-seeded and then somewhat longer.

Tidal forests of the Mahanadi delta! Fl. April–May. Fr. July–Oct.

Attains 1 foot girth with rough bark. Branchlets sometimes circinate, glabrous. Fls. ·12″ long. Bracteoles caducous. Calyx glabrous campanulate about half the corolla, upper lobes rounded, lowest larger lanceolate. Standard obcordate much exceeding the wings and keel. Ovary and pod stipitate.

55. PTEROCARPUS, *L.*

Large trees with alternate coriaceous exstipellate leaflets. Fls. yellow articulate on the pedicels, in panicled racemes with minute caducous bracts and bracteoles. Calyx turbinate, curved in bud, teeth short. Petals with long claws, standard and wings crisped. Stamens 5 + 5 or monadelphous with the sheath slit above only, or upper stamen free, anthers versatile. Ovary stipitate 2-ovuled. Pod orbicular with a broad wing, the apex displaced to near the base. Seed nearly always solitary.

1. **P. marsupium,** *Roxb.* Hid, *K.*; Murga, *S.*; Piasal, Bijasal, Paisar, *H.*; Bia, *Kharw.*

A handsome tree attaining large (7–10 ft.) girth. Leaves with 5–7 oblong or elliptic leaflets 3–5″ long with rounded or obtuse or retuse ends, glaucous beneath; sec. nerves close parallel, over 12 each side. Fls. ·5″ in dense flowered racemes on terminal panicles 6–10″ long and broad. Pod 1–1·75″ diam. with stipes ·2″ long.

Not recorded from the Northern area. Common in the Central and Southern areas and apparently in all districts except in the plains. Very common in Patna and Kalahandi States (*Cooper*). It thrives best on slopes near the nalas in the hills esp. on north aspects. Common on quartzite in Sambalpur.

Fl. Oct. Fr. Dec.–Jan. Nearly evergreen, leaves renewed May–June.

Bark cinereous, rather rough. Blaze grey streaked, then pink and finely lined, with exudation of red juice (Kino).

Var. **acuminata,** *Prain.* Lflts. ovate, acute or acuminate. Pods larger than in the type.

Rajmahal Hills, *Prain*! It appears to be very rare.

P. marsupium is one of the best trees for planking in the province and it deserves to be largely planted. The supply is not at present adequate. The wood is largely used for furniture, implements, wheels, etc. As a pole it has not much value and should therefore always be allowed to reach timber size. The liquid gum Kino takes about a fortnight to harden. (A note on its preparation is given in *The Indian Forester* for August, 1899.) It is a valuable medicine in diarrhœa. The leaves are used for buffalo fodder and trees have been seen actually felled for this purpose of giving a meal or two to buffaloes in the so-called protected forests of the Santal Parganas! "The average weight is 55 lbs." *Gamble.*

Trees raised by me from seed at Chaibassa showed after 16 years an average height of 32 ft. and girth 17·4″, but the locality is not favourable. Stools of Bija may be detected in the forest by their blackening from the exuding sap which is very rich in tannin.

56. DERRIS, *Lour.*

Trees or, always in our area, climbing shrubs. Leaves odd-pinnate with opposite leaflets, usually exstipulate exstipellate. Fls. small, solitary or usually fascicled on the rhachis on the branches of axillary or terminal racemes or panicles, bracts and bracteoles small and usually caducous. Calyx campanulate sub-truncate or with

short teeth. Corolla exserted. Standard broad, not auricled, wings often spurred above the long claw, somewhat adnate to the keel. Stamens usually monadelphous, but with upper filament free at base, rarely quite free, anthers versatile. Ovary sessile or shortly stipitate, few-ovuled. Pod usually thin, indehiscent, winged on one or both sutures, sometimes very narrowly. Seeds 1–few, reniform or orbicular.

Derris is in many respects closely allied to *Millettia* and except for the greater adhesion of the wings and keel the flowers are very similar.

A. Fls. in clusters on the rhachis of simple or panicled racemes.
- Lflts. 1–2 prs. Racemes 1–4″ not panicled . . . . . . 1. *uliginosa.*
- Lflts. 4–5 prs. oblanceolate. Racemes 1–4″ panicled . . . 2. *cuneifolia.*
- Lflts. 3–6 prs. lanceolate. Racemes 6–10″ . . . . . . 3. *scandens.*

B. Fls. not in racemes or clusters, copiously panicled.
- Lflts. 4–6 prs. oblong or ovate-oblong . . . . . . 4. *laxiflora.*

1. **D. uliginosa,** *Benth.* Ketia, *Or.*

A large climbing shrub with brown branches marked with prominent white lenticels, leaves only 3–5-foliolate, leaflets ovate to oblong 1·5–3″, or those on the 3-foliolate leaves sometimes 5″ by 2·5″. Fls. ·4″ long, white, 2–3-nate on a rhachis 5–7″ long, which is occasionally branched and bears 1–2 leaves. Pod orbicular, 1–1·3″ diam., with a very narrow wing on the upper suture.

Near the sea from Cuttack tidal forests! to Puri (near the Chilka Lake)! Fl., Fr. April–June.

L. rhachis together with comparatively long petiole 3–6″. Lflts. glabrous, base rounded, sec. n. 6–9 very fine, reticulate within the margin, nervules reticulate. Petiolule ·2″. Calyx campanulate nearly glabrous, teeth very short.

2. **D. cuneifolia,** *Benth.*

A large woody climber, the branches often tuberculate with the raised lenticels. Leaves large, 9–11-, rarely only 7-foliolate, with oblanceolate, oblong-obovate or narrowly elliptic glabrous leaflets which attain 7·5 by 3″, but may only be 1·5 by ·75″ at the base of the rhachis. Racemes short lateral often appearing before the leaves. Fls. ·4″. Pod 2–3″ by ·5–·6″, sessile, venose, thin, flat, narrowly winged on the upper, very narrowly or scarcely winged on the lower suture, 1–3-seeded.

Bettiah Forests, N. Champaran! Santal Parganas, ravines near Banjhi! It also occurs in the Morung Forest of Nepal close to Purneah! Fl. April–May before or with the new leaves. Fr. Nov.–Jan. Deciduous.

Branches often long and whippy. Lflts. slightly ferruginous-pubescent when very young, soon glabrous, base rounded, tip tapering or not, sec. n. 8–10 slender finely reticulate between. Petiolules ·25″ blackish in mature leaves. Racemes 1–4″ copiously panicled. Calyx ·12″ broadly campanulate glabrous except the densely pubescent rim.

3. **D. scandens,** *Benth.*

A large climbing shrub with brown lenticellate branchlets, and odd-pinnate leaves with 7–11 narrowly oblong, or few obovate-oblong or lanceolate leaflets ·7–3″ long coriaceous shining aud glabrous. Fls. ·3″ white or pink in clusters along the brown-pubescent rhachis of

long racemes usually far exceeding the leaves. Pods narrow 1·3″ and 1-seeded to 3–4″ and 3–4-seeded, ·4″ wide with a very narrow wing down the upper sutures.

Orissa, wild; Cuttack! Puri! Often cultivated in gardens. Fl. July-Sept. Fr. Sept.-Feb.

Stems attain 9″ girth with very large pores and rings of bast in the wood. L. rhachis very slender 1–4″ (longer in some eastern specimens). Lflts. occasionally somewhat shortly sericeous beneath, usually somewhat tapering to an obtuse tip, sec. n. about 8 very slender and scarcely longer than the intermediate, finely reticulate between. Petiolules ·1–·15″ slender pubescent. Racemes 3″–1 foot. Pedicels slender ·2″. Calyx subentire ·1″ sericeous. Pod sometimes repand on the lower or both sutures.

4. **D. laxiflora,** *Haines.*

A large woody climber with minutely rusty pubescent branchlets, 9–13-foliolate leaves with oblong or slightly ovate-oblong, rarely terminal somewhat obovate, leaflets 1–2·5″ long, rusty pubescent beneath, and very thinly finely sericeous above. Flowers solitary, ·35″ long in axillary and terminal lanceolar rusty tomentose panicles 4–10″ long. Ovary rusty-villous and young pod linear somewhat rusty pubescent. Pod oblong flat 2 by ·7″ narrowly winged on both sutures, sessile, 1-seeded.

Ramnagar Hills, N. Champaran! Fl. Aug.-Sept. Fr. Nov.-Dec.

The flowers were over in my specimens but remains were found in spiders' webs, the fruits mostly young. L. rhachis with petiole 2·5–6″ rusty pubescent. Lflts. sub-coriaceous with rounded often oblique base and shortly rather suddenly tapering acute or obtuse tip, midrib very pubescent beneath, sec. n. 5–7 not strong, nervules obscure below very minutely reticulate above. Petiolules ·1″. Branches of panicle erecto-patent short 2–3″. Bracts small persistent subulate. Pedicels ·2″. Calyx ·07″ long oblique truncate broader than long.

In leaf this plant resembles *D. scandens* except for the indumentum and fewer sec. n. but it differs wholly in panicle and fruit. It is most closely allied to *D. ferruginea* and *D. polystachya*, Bth., but the leaves of the latter are wholly glabrous and even the small-leaved forms of *D. ferruginea* have obovate leaflets and strong sec. n. The panicle of *D. ferruginea* has usually very long branches and fascicled flowers, moreover the young pod is much broader and very densely ferruginous hirsute. The inflorescence of *D. polystachya* resembles that of *D. ferruginea*.

57. PONGAMIA, *Vent.*

A tree with odd-pinnate leaves and opposite leaflets. Floral characters of *Derris*. Ovary sub-sessile 2-ovuled. Differs in the oblong pod, which is woody and not at all winged.

1. **P. glabra,** *Vent.* Karanj, *H., K.*; Kuruinj, *S.*; Darkaranja, *Beng.*; Kiramal, H.

Sometimes a large tree or sometimes, on the sea-coast, flowering as a shrub. Leaves 8–14″ long with 5–7 shining oblong or ovate cuspidate leaflets 2–5″ or sometimes up to 8″ long. Flowers lilac, those near the coast of a deeper colour than inland, 2–4-nate in simple peduncled axillary racemes on pedicels ·25–·6″ long. Calyx brown, corolla ·5″, standard silky. Pod woody glabrous 1-seeded, 1·5–2″ long and ·15–·2″ thick, with a short decurved point.

Indigenous throughout the greater part of the province along streams, and in the coastal forests. It is also found wild and of large girth (up to 5 ft.) on the top of the

Bhainsgot Hill (Puri)! Abundant along rivers in Athmallik and other of the Orissa States. Largely planted in all districts. It is possibly not indigenous in the Northern Area. Fl. May–June. Fr. Dec.–Jan. Deciduous in May but renews its leaves the same month.

Bark smooth thin grey. Blaze shows chlorophyll under the outer bark, then thin yellow.

The pods are very largely collected for the valuable oil expressed from the seeds, which is largely used for burning and for the cure of skin diseases. It is also used in rheumatism

A wonderful tree for adapting itself to diverse conditions, growing well with its roots in salt water, or fresh water, or exposed to the hot dry winds of Gaya and Chota Nagpur when planted along road-sides.

58. SOPHORA, *L.*

Trees or (in our area) shrubs with odd-pinnate leaves and showy yellow or purple, racemed or panicled flowers. Calyx oblique broadly campanulate with very short teeth. Standard broad, petals long-clawed. Stamens all free, or only obscurely connate at the very base, anthers versatile. Ovary stipitate, many-ovuled. Pod moniliform, indehiscent or dehiscent, joints turgid, sometimes winged.

1. **S. Bakeri,** *Clarke.* Bara Jirhul, *H.*; Mooa Bodi, *Birja.*

A shrub 4–5 ft. high with tomentose shoots and leaves 5–8″ long with about 7 prs. sub-opposite oblong silky leaflets, 1–1·25″, or up to 2″ long by ·75″ broad. Fls. purple in leaf-opposed racemes 4–6″ long. Pod 3–4″ moniliform, beaked, dehiscent, hairy.

Higher mountains and ridges in Singbhum! Ranchi and Palamau, ascending to the tops of the pats, common at Neterhat 3000 ft.! Parasnath! Fl. May–June. Fr. Oct.–March.

Lflts. subsessile, mucronate, glabrescent above. Calyx purple pubescent ·3–·4″ long, two upper teeth connate rounded. Standard ·5″ with inflexed margins, deep-purple, notched. Wings narrow-oblong. Keel rather shorter, purple-veined, auricled. Stamens 9 very loosely cohering. Ovary and pod stipitate.

FAM. 54. CÆSALPINIACEÆ (Leguminosæ).

Trees or shrubs, rarely herbs. Leaves 1–2-pinnate, but sometimes leaflets only 2 and sometimes these two combined, thus simulating a simple palminerved leaf (usually 2-lobed); sometimes sensitive (showing sleep movements). Flowers large or small, zygomorphic or sub-regular, usually racemose. Calyx sometimes spathaceous, generally 5-merous and perigynous with a short or elongate tube (hypanthium), sepals imbricate or valvate. Petals 5, more rarely fewer or 0, free, imbricate, posterior innermost in bud and often different. Stamens normally 10, but some often reduced to staminodes or altogether abortive, inserted on the hypanthium, rarely connate. Ovary free or somewhat adnate on one side to the hypanthium, as in the Papilionaceæ, but more frequently indehiscent and samaroid in fruit and never breaking up into one-seeded joints.

The germination is generally epigeal or sub-epigeal, *i.e.*, with the somewhat fleshy cotyledons elevated on a very short hypocotyl or hypocotyl suppressed.

I. Leaves 1-pinnate or simple (of two connate leaflets).
  A. Hypanthium very short.
    Petals 5. L. several-foliolate . . . . 1. *Cassia.*
    Petals 0. L. 6-foliolate . . . . 2. *Ceratonia.*
    Petals 0. Leaflets 2 only . . . . 3. *Hardwickia.*
    Petals 5. Leaflets usually combined into one . . . 4. *Bauhinia.*
  B. Hypanthium elongate.
    1. Petals 5–3.
      Leaflets two usually combined into one leaf . . . 4. *Bauhinia.*
      Leaflets several. St. 9+1 (diadelphous) . . . . 5. *Amherstia.*
      Leaflets many. St. 3 . . . . 6. *Tamarindus.*
    2. Petals 0. Calyx petaloid. Lflts. several . . . . 7. *Saraca.*
II. Leaves 2-pinnate.
  A. Sepals valvate. Fls. 2-sexual.
    1. Unarmed trees with distinct rhachis to leaves.
      Sepals petaloid, unequal, 4 upper connate . . . 8. *Colvillea.*
      Sepals subequal, green . . . . 9. *Poinciana.*
    2. Thorny small tree with very abbreviated rhachis . . 10. *Parkinsonia.*
  B. Sepals sub-imbricate. Fls. polygamous.
      Tree with copious branched thorns . . . . . . 11. *Gleditschia.*
  C. Sepals imbricate. Fls. 2-sexual.
    1. Ovary adnate at base to hypanthium.
      Seed enclosed in the wing-like endocarp of the dehiscent pod . . . . 12. *Schizolobium.*
    2. Ovary quite free from hypanthium.
      a. Pod broadly winged, indehiscent.
        Unarmed tree. Hypanthium shallow . . . . 13. *Peltophorum.*
        Prickly climber. Hypanthium deep . . . . 14. *Mezoneuron.*
      b. Pod not or scarcely winged, dehiscent or not.
        Erect or climbing, often prickly . . . . . 15. *Cæsalpinia.*

1. CASSIA, *L.*

Trees, shrubs or sometimes herbs with even-pinnate leaves and few or many leaflets. Flowers in axillary racemes and terminal panicles, rarely in axillary pairs. Calyx-tube very short. Petals subequal, usually somewhat zygomorphous. Stamens 10, frequently unequal or some reduced to staminodes, anthers dehiscing by a short slit or terminal pore. Ovary linear, many ovuled. Pod variable in shape, septate, dehiscent or not.

A large genus with many species found in gardens not here referred to. Many possess purgative properties. Senna Tea is the leaves of two species of *Cassia.*

A. Trees, shrubs or herbs with broad obtuse sepals and large or mod.-sized leaflets.
  I. Trees. Stamens 10 antheriferous, 2-3 lower anthers different from the others. Pods indehiscent.
    1. Fls. in lax pendulous racemes, very large yellow . 1. *fistula.*
    2. Fls. in erect corymbose racemes, red or pink.
      a. Thorny. Lflts. oval 1–2″ glabrescent. Fls. 1·5–2″. 2. *javanica.*
      b. Unarmed. Lflts. oblong or lanceolate-oblong.
        Lflts. 2–3″. Fls. 1·5–2·5″ . . . . 3. *nodosa.*
        Lflts. ·8–1·5″ pubescent. Fls. 1″ . . . . . 4. *marginata.*
  II. Stamens 10, 6-7 only antheriferous (exc. *glauca*), 2–3 lower larger, 3-4 posterior reduced to staminodes. Pod dehiscent.
    1. Tree. Leaves without glands . . . . . . 5. *siamea.*

2. Shrubs or herbs. Rhachis or petiole with glands.
   a. Rhachis usually with several glands between the leaflets.
      Large shrub. All anthers perfect and sub-equal . 6. *glauca.*
      Large shrub. Stipules large semi-cordate. Lflts. 8–12 prs. . . . . 7. *auriculata.*
      Undershrub. Lflts. 3 prs. Glands 1–2 only . . 8. *tora.*
   b. Gland only on top of petiole.
      Lflts. 3-5 prs. more or less ovate . . . . . 9. *occidentalis.*
      Lflts. 6–12 prs. not at all ovate . . . . . . 10. *sophera.*

B. Undershrubs or herbs with narrow acute sepals and (exc. *absus*) numerous very small sub-falcate leaflets.
   1. Lflts. mod.-sized only 2 prs. . . . . 11. *absus.*
   2. Lflts. small and many.
      a. Petiole with a large sessile gland. Stamens 10 (–9).
         Lflts. 20–40 prs. ·3–·6″ long . . . . 12. *Leschenaultiana.*
         Lflts. 40–70 prs. ·15–·2″ long . . . . . . 13. *mimosoides.*
      b. Petiole with a long stipitate gland.
         Stamens 5. Fls. very small, under ·2″ . . . 14. *pumila.*
         Stamens 10. Fls. over ·2″ . . . . 15. *Kleinii.*

1. **C. fistula,** *L.* Hari, *K.*, Mirju-baha, Nuruc', and the pod Bandarlari, *S.*; Danbar, Dhanrach, *Kharw.*; Sonarki, *Uran*; Sundaraj, Amaltas, *H.*; Sonari, *Or.*; The Indian Laburnum (but the true Laburnum is one of the Papilionaceæ).

A small or m.s. tree, very handsome in flower, with large, closely veined ovate, ovate-lanceolate or ovate-oblong acuminate or acute leaflets 2–7″ long. Flowers 1·5–2·5″ diam., light bright yellow in long pendulous racemes, succeeded by long cylindrical drooping pods 1–2 ft. long and 1″ diam.

In all districts wild and planted. Indifferent as to soil and aspect, but never at all gregarious. Frequent on the Khurda laterite! Fl. May–Aug., but the pods may be found on the tree nearly all the year round and fall about April. Deciduous March–April.

Bark smooth pale or white. Blaze rather hard, red-brown slightly streaked. Lflts. 4–8 prs. with close strong sec. n. Racemes 1–2 ft. Pedicels long. Pods ultimately black, indehiscent with the flat transverse seeds embedded in flesh which is eaten by jackals, bears, etc.

The wood is hard, strong and heavy (about 60 lbs.) and much in demand for carts and agricultural implements. It is largely used for house posts for which it is well adapted as the tree does not grow to the size of large timber. It also gives a good firewood and charcoal, but the chief use of the tree lately has been for tanning bark, and in 1917–18 considerable leases were given out for its collection from the reserves, while Re 1/- per maund was paid for it in the Orissa States. It is said to be a good mixture with "tarwad." As the tree coppices readily and the poles are in demand, the sale of the bark for tanning is not as wasteful as it might seem. The flowers are eaten. Decoctions of the leaves and fruit are used as laxatives and the pulp round the seeds is the *Cassiæ pulpa* of the *Brit. Pharmacopœia.* It is made into a sherbert in Chota Nagpur. The seedlings at first are very slow growing. *Gamble* gives rate of growth as 9 rings per inch of radius.

2. **C. javanica,** *L.* Syn. C. bacillus, *Gaertn.* (*F.I.*).

A small tree with grey or brown bark, often thorny. Branches numerous spreading often flexuous with bifarious leaves about a foot long bearing 10–16 pairs of oval leaflets 1–2″ long with very obtuse rounded or emarginate sometimes apiculate tip. Very handsome in flower with bright rose or pink flowers, 1·5–2″ diam in elongating bracteate corymbs 4–6″ broad. Pod like that of *C. fistula,* 18–24″ long, flesh dry not pulpy.

Common in gardens! Fl. chiefly in the hot season.

Youngest branches and leaf rhachis thinly tomentose. Stipules lunate caducous, lower horn lanceolate, upper horn broader rounded or emarginate. Lflts. often few near the raceme, somewhat pubescent when young. Racemes terminal and axillary. bracts lanceolate stipulate (cordate *Roxb.*). Sepals ovate, reddish.

Following the usual custom I take *Roxb.'s C. bacillus* to be the Linnean *C. javanica*, but the description of the latter in the *Species Plantarum* might as well be one of the following, and it is given as a native of India, whereas our species is a native of Java and the Malay Peninsula.

3. **C. nodosa,** *Ham.*

A small tree with spreading and weeping branches and bifarious leaves about a foot long (9–15″) with 11–14 pairs of oblong or somewhat lanceolate-oblong leaflets 2–3″ long, but sometimes much smaller towards the base of the rhachis, chiefly distinguishable from the last by being somewhat narrowed and obtuse, acute, or very shortly acuminate at the tip. Equally handsome in flower, with pink or rose flowers 1·5–2·5″ diam. in elongate bracteate corymbs which are usually lateral on branchlets other than the new ones. Pod similar.

Often cultivated in our area (*e.g. Ranchi*)! Fl. most of the rainy season. It is a native of India.

Young branches downy. Leaf rhachis pubescent when young. Stipules ·5–·8″ lunate with both horns cuspidate. Lflts. puberulous beneath, base slightly unequal, sec. n. about 14. Bracts subpersistent reddish ovate-lanceolate acuminate ·3″. Fls. very sweet-scented. Pedicels red 1·5–2″ long. Sepals red ·2″. St. anterior 3 long declinate with a bulbous swelling on the yellow filament and fertile hairy anthers, 4 shorter arched with spurs opening by pores, nearly glabrous. Three apparently unfertile shorter with incurved filaments. Ovary hairy.

4. **C. marginata,** *Roxb.* Syn. C. Roxburghii, *DC.*; C. javanica, *F.C.N.*

A low tree with long spreading and weeping branches, tomentose branchlets and bifarious leaves 6–10″ long with 8–20 prs. of oblong unequal-sided leaflets ·8–1·5″ long with rounded or emarginate and apiculate tip. Easily distinguished from the preceding two by the young leaves being densely yellow pubescent and the old ones silky below minutely pubescent above. Fls. deep rose-red only about 1″ diam. in axillary and terminal corymbose racemes on the current year's shoots. Pod 8–12″ long, often curved, flesh spongy.

Cultivated only in our area (*e.g. Dumka*)! Fl. Nov.–Dec. Native of India.

5. **C. siamea,** *Lamk.* Sometimes called Siris in Chota Nagpur and Chakundi in Orissa, neither name properly belonging to it.

A mod.-sized tree with leaves 6–12″ long, 6–14 prs. of oblong leaflets 1·5–2·5″ long and numerous very large erect or inclined panicles of bright yellow flowers. Pods flat 6–9″ long, many-seeded.

Not indigenous but very commonly planted and self-sown. Fl. Sept.–Dec. Evergreen.

Lflts. emarginate with a small bristle from sinus. Panicle composed of numerous corymbose racemes.

A very rapid grower attaining 20 ft. in 2–3 yrs. in Singbhum, but short-lived, and very little else will grow in its vicinity. The heart-wood is deep-brown but useless.

6. **C. glauca,** *Lamk.*

A handsome shrub or small tree. Leaves with 4–6 prs. of ovate glaucous leaflets 1·5–4″ long, usually with glands between the

leaflets. Flowers bright yellow in axillary corymbs with reflexed bracts. Stamens 10 with anthers similar but two lower filaments longer. Pod flat and thin 6–8″ long.

Frequent in gardens! *Campbell* gives Manbhum as a locality with the *Santali* name of Bheda-dereng and says that the root is given in epilepsy. The plant was, no doubt, only cultivated.

7. **C. auriculata,** *L.* Tarwad, *Vern.*

A much-branched handsome shrub 3–10 ft. high with hairy twigs and leaves, 8–12 prs. of elliptic obtuse mucronate hairy leaflets ·6–1″ long, and large yellow flowers in subterminal corymbs. Easily recognised by the large broad foliaceous obliquely cordate stipules on the younger leaves. Pods 3–5″ long by ·7″ broad, flat, obtuse each end. Seeds 6–10.

It is not indigenous in our area but has been recently sown in several divisions on account of the scarcity of good tanning material during the war. In the Central Provinces it flowered Oct.–Jan. and fruited Jan.–March and was partial to cotton soil.

Fresh tarwad bark contains over 20 per cent. of tannin. Mr. Fraymouth, Director, Esociet Tannin Research Factory, Maihar, said before the Tannin Conference at Dehra Dun in 1917 that the leather-making properties of this bark are quite exceptional, and "I doubt if any other tan-stuff can be found to provide a complete substitute for *turwad*."

I found the plant very easily grown from seed at Nagpur and it attained 4–5 ft. and flowered in the first year, on cotton soil.

8. **C. tora,** *L.* Inc. C. obtusifolia, *L.* Syn. Senna toroides, *Roxb.*; Jomaikaiu, *K.*; Bheda-deren, chakoara, *S.*; Chekor, *Kharw.*; Chakunda, *H.*

An erect herb 1–5 ft. high with 3 prs. of obovate obtuse rounded or retuse leaflets, the pairs increasing in size from the base of the rhachis upwards. Fls. ·5″ diam. axillary paired or solitary. Pods sub-terete or 4-angled very slender, falcate, 6–12″ long, incompletely septate with numerous brown oblong seeds ·12″ long.

Very common and sub-gregarious in waste ground in the rains, but also found in forest glades where it attains 5 ft. in height! Fl. Sept.–Oct. Fr. Nov.–Dec. Annual.

Lflts. 1–2·5″ long, glabrous or thinly villous with a linear gland between the lowest or two lower pairs, sub-sessile or shortly petioluled, odour usually fœtid. Stipules setaceous. Fls. usually two on a very short peduncle but one often abortive.

Var. **obtusifolia,** Syn. Senna toroides, *Roxb.*

Roxburgh describes this as a more robust plant than *C. tora* with a single subulate gland only. Fls. larger, one always abortive and with little or no smell.

In our area at least the plants pass into one another, the large robust form in the Betlah forest having two glands, and I have actually grown plants with leaves fœtid and glaucous beneath and only bearing one gland except on the lowest one or two leaves, which had two. Such plants may also be discovered in the wild state.

The young leaves (Chakaoda ara, *K.*) and the pods are eaten. Both leaves and seeds contain chrysophanic acid and therefore constitute a valuable remedy in ringworm and itch. The leaves are gently aperient (*Nadkarni*).

9. **C. occidentalis,** *L.* Kaiu, *K.*; Kasondi, *H.*; Kalakashunda, *Beng.* Sometimes called *Negro Coffee* in English from the roasted and ground seeds having been used as a substitute for coffee.

An erect stout herb, or suffruticose, 2–4 ft. high with leaves 6–12″

long with about 4–5 prs. of ovate or ovate-oblong or ovate-lanceolate lflts. 1·5–4″ long. Flowers yellow ·5–·75″ diam. rarely sub-solitary, usually in axillary and terminal racemes, sometimes panicled. Pod 4–5″ long, flattened, slightly falcate, septate between the numerous seeds.

A very common weed on waste ground during the rains. Fl. Sept.–Nov. Fr. Dec.–Jan. Annual.

Whole plant fœtid. Stems often grooved. Petiole with a large tumid gland above its base. Lflts. sometimes lanceolate and acuminate. Stipules semi-ovate acuminate caducous. Axillary racemes very short, terminal many-flowered.

The leaves, roots and seeds are purgative and are said to be useful in cough and whooping-cough. The plant is also used for skin diseases in the same way as the last.

10. **C. sophera,** *L.* Bas-ki-kasunda, *H.*

A shrub 4–7 ft. high, stouter than the last, and the leaves with 6–12 prs. of lanceolate or narrow-lanceolate finely acute or acuminate leaflets mostly 1–3″ long. Fls. 1–1·5″ diam. in short axillary and terminal panicles. Pod sub-terete or terete 2·5–3″, straight or very slightly curved. Seeds very many compressed.

All districts but not nearly as common as *C. occidentalis* and usually in hedges near villages. Fl. Aug.–Dec. Fr. Nov.–Dec., but also found in flower and fruit sometimes March and April.

This also has a single gland just above the petiole, but it is subulate, not tumid.

The properties and uses are practically the same as in the last two and an infusion of the bark or powdered seeds is said to be good for diabetes. An infusion of the leaves is given in rheumatic fever and as an anthelmintic and as an injection in gonorrhœa (*Nadkarni*).

11. **C. absus,** *L.*

An erect viscous-hairy herb 9–18″ high with only two prs. of ovate or rhombic-ovate leaflets ·6–·9″ long and terminal racemes of small yellow or red flowers with only 4 stamens, all perfect. Pod flat hairy 1–1·5″ long, seeds black shining.

Chota Nagpur! Frequent. Probably in all districts. In somewhat open stony jungles and waste ground. Fl., Fr. Aug.–Oct.

Petiole 1–2″. Stipules acicular hairy. Racemes 1–2″ long.

12. **C. Leschenaultiana,** *DC.*

A slender erect but stouter plant than *C. mimosoides* with slender branches and leaf rhachis clothed with straight spreading hairs. Leaves 1·5–4″ long with distinct petiole bearing a sessile gland. Leaflets 20–40 prs., ·3–·6″ long. Flowers on long pedicels, two or more, rarely solitary on a very short extra-axillary peduncle clothed with pairs of stipule-like bracts. Sepals subulate, sub-aristate acuminate. Stamens 10 perfect or only 8–9, 4 anthers usually larger ·16–·2″ long. Pod 1–2″ long, linear-oblong, flat, hairy, about 15-seeded.

Purneah! Ranchi and Palamau, elev. 3000 ft. in damp places! Fl. Aug.–Sept. Fr. Oct.

Stipules lanceolate-acuminate with sub-oblique or semi-cordate many nerved base. Lflts. linear sub-falcate sub-aristulate. Buds ovoid long-beaked with the tips of the sepals. Sepals subulate. ·45″ long, hairy. Petals shorter. Seeds small pale-brown shining, oblong with oblique base.

13. **C. mimosoides,** *L.* Syn. Senna tenella, *Roxb.*, also S. sensitiva, *Roxb.*? Ot-kondro, *S.*

A slender erect or somewhat diffuse undershrub with many slender branches and leaf rhachides clothed with erect somewhat curled hairs. Leaves 2–3·5″ with a very short petiole bearing a sessile gland. Leaflets very small and many, 50–70 prs., ·16″ long. Fls. solitary, rarely two, with very slender pedicels arising from a pair of extra-axillary bracts. Sepals ·3″ slender tapering both ends. Petals shorter. Stamens 10 perfect, 4–5 anthers distinctly larger than the others, the longer ones ·12–·14″. Pod 1–2″, 15–25-seeded.

Usually in grass lands. Frequent in Chota Nagpur. Fl., Fr. r.s.
Stipules ·3″ subulate with a filiform tip and a very broad sometimes sub-cordate base, strongly-nerved. Leaflets sensitive, closing up in the sleep position so that the leaf is only ·045″ wide, sub-falcate, mucronate. Bracts rarely two pairs on the very abbreviated sessile raceme; pair of bracteoles near top of pedicel about half as long as the sepals. Buds with appressed hairs, ovoid, beaked with the tips of the sepals.

14. **C. pumila,** *Lamk.* Ot-kondro, *S.*

A diffuse or prostrate herb with many stems 8–15″ long, pubescent or sub-villous with curled hairs. Leaves very variable, ·6–1·7″ in smaller, 1–3·5″ in the larger forms, with hairy rhachis, a long stipitate gland on the short petiole and sometimes one or more on the rhachis. Lflts. 6–25 prs. (sometimes on same plant), rapidly decreasing in size from the base to apex of rhachis, lower ·2′ long in the smaller, ·5–·6″ long in the larger forms, hairy or glabrous excepting the hispid margin, midrib produced into a short awn. Fls. very small, shortly pedicelled, 1–3 on a short bracteate extra-axillary peduncle. Sep. ·12–·15″, narrow, subaristate, 3 outer hairy on back, petals ·1–·12″. Anthers 5 about as long as filament. Pod flat, thinly villous or glabrescent, ·8–1·2″ with thickened sutures, 8–11-seeded.

Frequent in waste ground and pastures. Behar, ***Prain*** ! Chota Nagpur! Santal Parganas, *Gamble, Kurz* ! Fl., Fr. Sept.–Oct.
Stipules narrowly lanceolate, spinose tipped. Lflts. sub-falcate. Bracts on peduncle geminate subulate and two small bracteoles at apex of pedicels. Ovary densely villous.

15. **C. Kleinii,** *W. & A.*

Habit of *C. pumila* and indistinguishable without flowers. Leaflets more often nearly glabrous and nearly always over ·1″ long. Fls. much larger on a longer peduncle which often attains ·7–·8″ in fruit. Sep. ·2″, three usually broadly-lanceolate, petals 2″, anthers 10, 2–3-times as long as filament. Ovary usually only villous on the margins, style longer and less curved. Pod nearly straight erect or ascending 1·5–1·9″ long, about 12-seeded.

Rare. Western Behar, *Bengal Plants.*
This may be merely a large-flowered variety of *C. pumila* in which the 10 stamens are correlated with the larger flowers, or (more probably) *C. pumila* is a variety of this species.

Ceratonia siliqua. *L.* Carob Tree; Locus; St. John's Bean.

A small or m.s. tree with a dense evergreen crown and even-pinnate leaves with usually 3 pairs of coriaceous elliptic rounded or retuse leaflets. Flowers small, polygamo-diœcious, in short spikes from the axils of fallen leaves with very small

deciduous bracts and bracteoles. Hypanthium saucer-shaped with 5 small teeth, filled with a broadly peltate disc. Petals 0. Stamens 5. Ovary shortly stipitate, ovules many, stigma peltate. Pod linear-oblong, thickly coriaceous, indehiscent with thickened sutures and full of a sweet nutritious pulp, which is eaten raw, and forms in some of the Mediterranean countries an important cattle food.

The tree was grown some years ago in Hazaribagh and in Puri but I believe has not thrived. I have however no recent accounts of it.

3. HARDWICKIA, *Roxb.*

A tree with paripinnate leaves of only two palmately-nerved leaflets. Flowers very small numerous in panicled racemes. Calyx-tube very small, disc sub-basal. Sepals 5, rarely 4, oblong, imbricate, petaloid. Corolla 0. Stamens twice as many as sepals, alternate longer, anthers versatile. Ovary sessile, 2-ovuled. Pod samaroid, dry, apically dehiscent. Seed 1, apical, exalbuminous.

Germination epigeal but cotyledons usually raised but a short distance above the ground. Cotyledons rather fleshy, obcuneate-oblong, nearly 1″ long, base with two small auricles indistinctly 3–4 nerved.

1. **H. binata,** *Roxb.* Anjan, *H., Kharw.*

A large and beautiful tree with drooping branchlets and glaucous foliage, the small leaves resembling those of a *Bauhinia* but with the two leaflets quite distinct, sessile, about 1–2″ long, obliquely rhomboid or ovate obtuse 4–5-nerved. Fls. whitish in axillary and terminal panicles. Pod samaroid linear-oblong 2–3″.

On sandstone in the Kymore Hills, formerly abundant and attaining 120 ft. in height (vide *Hooker*, Himalayan Journals); Palamau, near the Sone! Gregarious in patches. Fl. July-Aug. Fr. Feb.-March. Evergreen or nearly so; new shoots in April.

Attains 7–8 ft. girth but the forests not having been reserved large trees are now rarely found, though coppice shoots are frequent. Bark rough dark grey.

The wood is very hard and heavy, deep red and sometimes nearly black in colour. *Gamble* gives the weight as from 60 to 84 lbs. This extreme weight militates against its more extensive use for sleepers and construction. It is used for cart wheels and implements. The young trees are extensively lopped and mutilated for fodder and for the fibre of the bark. Although found on the Kymore sandstones it was common and easily grown on trap in the Central Provinces. The tree has to be sown *in sitû* for artificial propagation.

Some useful sylvicultural notes by *L. S. Osmaston* will be found in the *Indian Forester* for June and July, 1909.

4. BAUHINIA, *L.*

Trees or shrubs, sometimes climbing by means of circinate tendrils, with two leaflets as in *Hardwickia* but usually connate into a broad palmately-nerved 2-lobed, rarely entire, simple leaf with rounded or cordate base and mid-rib (rhachis) ending in a bristle. Flowers usually large or m.s., rarely small, in simple or panicled sometimes corymbose racemes, rarely only 2–3 axillary. Hypanthium usually thickened and tubular or turbinate, calyx lobed or spathaceous. Corolla with clawed petals somewhat zygomorphic, the posterior usually different from the others or sub-regular. Stamens normally 10, often reduced, occasionally only 1–3 perfect, anthers versatile. Ovary stipitate, stipes free or adnate to the side of the hypanthium. Pod linear to oblong, coriaceous or woody, dehiscent, rarely indehiscent, several or many-seeded. Seeds compressed, albuminous.

The germination in those species examined is sub-epigeal, the orbicular oblong sessile rather fleshy cotyledons turning green but lying close to the earth.

A. Erect trees or shrubs.
- I. Fertile stamens 10. Calyx with short tube and spathaceous 5-toothed limb.
  - *a*. Small trees. Fls. rather small, not showy.
    - L. mostly under 2″. Racemes simple with short pedicels . 1. *racemosa*.
    - L. mostly over 2″. Racemes sub-corymbose, lower pedicels long, far exceeding the bracts . . . . 2. *malabarica*.
  - *b*. Shrubs with showy white or yellow flowers.
    - Fls. 1–3 axillary usually yellow . . . . . . 3. *tomentosa*.
    - Fls. in short racemes, pure white . . . . . . 4. *acuminata*.
- II. Fertile stamens 3–5. Calyx tube elongate (exc. in *B. retusa*).
  - *a*. Leaves deeply lobed. Flowers large.
    - Fl. buds not angled. L. deciduous when flowering . . 5. *variegata*.
    - Fl. buds sharply angled. Fls. with leaves . . . . 6. *purpurea*.
  - *b*. Leaves scarcely lobed. Fls. small white . . . . 7. *retusa*.

B. Large climbers. Fertile stamens 3–5.
- L. with rounded lobes. Fls. over 2″ diam. . . . . . 8. *Vahlii*.
- L. with acute or acuminate lobes. Fls. very small . . . 9. *anguina*.

1. **B. racemosa,** *Lamk.* Kaimu, *K.*; Katmouli, Kathul, *Kharw.*; Ghatouli, *Ur.*; Ambalota, *Or*; Kathal, *Or.* (fide *Cooper*).

A small tree with pubescent branches, small leaves broader than long, tomentose or pubescent especially on the nerves beneath and small whitish flowers in simple, not corymbose, tomentose racemes 2–3·5″ long. Calyx spathaceous, petals linear oblanceolate. Pod 4–7″ rarely 10″ long, thick, sometimes slightly torulose, septate, not beaked or with very short beak under ·2″.

Central and Southern tracts. Usually in the dryer mixed forests! Manbhum! Hazaribagh! Ranchi, on the Ghats! Palamau, Betlah forest, frequent! S.P.! Athmallik! Puri, Baruni Hill! Angul, towards Khatada! Sambalpur! *Cooper* says common in the Orissa States. Fl. April–June. Fr. Nov.–Feb., but persisting till April. Evergreen.

Bark dark rough grey with dark-pink blaze. Leaves 1–1·5″ by 1·5–2·5″ pale glaucous beneath, lobed one-third way down, lobes obtuse, base shallow-cordate 7-9-nerved. Bracts linear-subulate about as long as pedicels. Corolla scarcely exsert, anthers densely villous. Seeds ·12″.

The pod is variable. A very thick form occurs on sandstone and conglomerate but there is also a falcate less turgid variety. The wood is only used for fuel. The bark yields a fibre.

2. **B. malabarica,** *Roxb.* Laba, *K.*; Jhinjit, *S.*; Koinar, *Turia*; Sahul, *Th.*; Koteli, *Or.*; Ampti, *H.*

A small tree attaining 4 ft. girth with a bushy crown and dark green leaves 1–4″ diam. broader than long, glabrescent and grey beneath. Fls. sub-regular whitish on slender pedicels in tomentose sub-corymbose racemes 2–3″ long which are mostly in a corymbose panicle. Pod 7–12″ by about ·75″ flattened, mostly curved, rostrate.

Usually a tree of moist localities and in the dryer districts loving the vicinity of streams. Throughout the whole province. Bettiah Forests, Champaran! Santal P.! Singbhum, on northern slopes and along valleys, frequent! Manbhum! Hazaribagh (Parasnath, etc.)! Puri! Angul! Sambalpur, frequent! Fl. Sept.–Nov. Fr. Jan.–March. Evergreen.

Bark light brown-grey nearly smooth or with linear-oblong flakes when old. Blaze hard pinkish red and pink turning red, or bright deep crimson in old trees. Shoots pubescent or tomentose. L. lobed one-eighth to one-quarter way down, sometimes permanently minutely pubescent beneath, base cordate, 7–11-nerved, petiole 1–2″ usually black at the thickened tip. Calyx ·25–·5″, limb shortly 5-lobed.

petals slightly exsert, oblong-spathulate. Pod usually described as reticulato-venose, but this only appears when dry.

The wood is only used for fuel. The leaves have a pleasantly acid taste which may be used to discriminate this species from the last when only foliage is available and there is any doubt.

3. **B. tomentosa,** *L.*

A handsome shrub with young parts tomentose, 7–9-nerved leaves 2–3″ long, rather broader than long, lobed less than half way down into two obtuse lobes, laxly pubescent beneath. Fls. yellow or white, shortly bluntly beaked in bud, in axillary or leaf-opposed peduncled pairs with linear bracts and bracteoles. Calyx spathaceous ·5″, corolla 2″. Pod brown 4–5″ long by ·5″.

Frequently cultivated in gardens! *Wood* cites Tamar, 500–1000 ft., as a locality, without remark. Fl. July–Aug. Fr. Jan.-Feb.

4. **B. acuminata,** *L.* Ahalad, *S.*

A large shrub 6–15 ft. high with shoots curly pubescent, not tomentose, 7–11-nerved leaves often small 1·5–2·5 but in favourable situations attaining nearly 6″ long and broad with petiole 1·5″, lobed over one-third to half way down into two acute or acuminate lobes, sparsely pubescent beneath. Flowers pure white well characterised by the long-beaked buds and long acuminate or beaked spathaceous calyx. Pod 4–5″ by ·7″ beaked, widest above and tapering downwards, about 7-seeded.

Wild in the Santal Parganas, in cool places on Trap rock on the north side of Kandeshari Pahar! Wild on the Baruni Hill, Khurda! Very frequently cultivated in gardens! Fl. May-Aug. Fr. Jan.-April. Nearly evergreen.

The flowers are in short racemes 1–3″ long with a pure white corolla 2·5–3″ diam. The buds have beaks ·5″ long.

5. **B. variegata,** *L.* Buj, Juruju, Burunga, *K.*; Jantai, *M.*; Jhinjir, *S.*; Kachnar, *H.*; Kandol, *Bhumij.*; Lalkangchan (the red), Vagakangchan (the white), *Beng.*

A small or m.s. tree with 13–15-nerved leaves 2·5–6″ by 3–6·5″, lobed about one-fourth to one-third the way down into rounded lobes, grey-glaucous and pubescent especially on the nerves beneath. Flowers large pure white or pink or purple with one petal variegated yellow, in short racemes mostly from leafless axils, flower buds terete. Pod 6–12″ by ·75–1″ flat, dehiscent.

Naturally a tree of dry rocky hills and very beautiful in the forest. Chota Nagpur, all districts! Santal Parganas, Rajmahal Hills, occasional! Probably in all the hill districts of the Central and Southern Areas. Often cultivated in gardens and will sometimes flower in its second year as a shrub. Fl. Feb.-March, the upper part of the tree being more or less leafless at the time. Fr. April-May.

Bark grey longitudinally cracked, blaze pale pink or flesh-coloured darkening on exposure. Primary nerves sometimes only 11. Petiole ·5–1·75 pubescent stout. Calyx spathaceous, tube 1–1·25″, limb broad ovate. Petals obovate 2–2·5″ long. Perfect stamens usually 5 without staminodes. Pod very venose when dry and mature, papillose when young, stipes 1″ long.

The wood is only used for fuel. The bark yields a fibre and is both eaten and used medicinally, *Campbell.* The flowers and flower-buds are sometimes eaten. *Kadkarni* says that the bark is astringent, tonic and alterative, and a decoction is useful in diarrhœa. The flowers are laxative. The dried buds are also useful in diarrhœa and worms, and a decoction of the root is an anti-fat remedy.

6. **B. purpurea,** *L.* Koilara, *Th.*; Sing-ara, *M.*; Sing-a, *Ho.*; Sinhara, *S.*; Koinar, *Kharw.*; Kundrau, *Mal P.*; Sona, *H.*; Deva-kanchan, *Beng.*

A m.s. tree but not infrequently flowering as a shrub, with 9–11-nerved very deeply lobed often oblong leaves 5–7″ long, lobes with usually angular tips. Fls. large purple in terminal panicled racemes with *acutely* 5-*angled* flower-buds. Pod 6–12″ by ·75–1″ narrow below, nearly always somewhat broadening upwards, flat, dehiscent when ripe with thin coriaceous twisted valves.

Frequent in all districts, especially in valleys and often grown in the villages. Fl. Sept.-Dec. Fr. Jan.-March.

Twigs glabrous. Bark ashy or dark brown, blaze with or without a pink outer layer, then pale yellow rapidly darkening, then nearly white but centre (on wood) again yellowish. Twigs glabrous. Leaves split from one-third of the way down often to near the base, glabrous or minutely puberulous on the nerves beneath, green, scarcely glaucous and much more membranous than in *B. variegata*. As in other *Bauhinias* very small leaves are sometimes present on same shoot with others. Petiole 1–1·5″. Calyx spathaceous, limb ·75″, the turbinate tube ·25–·3″ only. Petals oblanceolate 1·25–2″ long, often variegated, long-clawed. Stamens 3–2 perfect and staminodes filamentous.

The bark gives a fibre. The leaves are eaten as vegetables (a :, ara, *K.*). The tree is frost hardy.

Var. *α* **triandra,** *Roxb.* (sp.).

A smaller-flowered form with pink flowers with a dark crimson centre. The leaves are also broader with a broader sinus, petals cuneate obtuse.

On limestone, Naga Untari (Palamau)! Fl. Nov.-Dec.

This is probably *Roxburgh's B. triandra.*

7. **B. retusa,** *Ham.* Laba, *K.*; Birnju, Bunju, Jhinjit, *S.*; Kaamaun, Katmauli, *Kharw.*; Tewa, *Ur.*; Kanla, *H.*; Choari, *Or.*; Panki, *Khond.*

A m.s. tree with entire or only slightly emarginate 7–11-nerved leaves 4–7″, rather broader than long with a cordate or straight base. Flowers only 1″ diam. zygomorphic, white with the three upper petals purple-mottled, in corymbose racemes arranged in ample terminal panicles. Pods straight, sub-oblong but rather broader upwards, 5–7″ by 1·25–1·75″ thin and deep red till ripe.

Hill districts of the Central and Southern tracts. Especially common on northern slopes in Chota Nagpur! Common in Angul, Mayurbhanj and Sambalpur in valleys and on quartzite hills. Fl. Sept.-Dec. Fr. Feb.-March. Evergreen.

Bark dark grey-brown, blaze very pale pink. L. green beneath easily distinguished by the entire or scarcely divided apex. Calyx-tube scarcely any. Petals subrhomboid above the long claws. Stamens 3.

The bark yields a fibre and gum, the latter used in sweetmeats. *Campbell* says that the leaves have a bitter diagreeable taste. The tree is frost hardy. The stem above the cotyledons is remarkably long and slender up to the first pair of foliage leaves which are opposite!

8. **B. Vahlii,** *W. & A.* Maulan, *Th.*; Maholan, *Kharw.*; Maljan, Mahul, *H.*; Jom-lar, Lamak' lar, *S.*; Sialpatta, *Or.*

An immense climber with villosely tomentose shoots and young parts, simple circinate tendrils mostly leaf-opposed, deeply 2-lobed deeply cordate leaves from 2″ to 18″ diam. and corymbs of large

white or cream-coloured flowers. Pod woody 6–12″ by 1·5–2″, flat, velvety.

Throughout the province but especially on the hills and in stony ravines. Fl. April–June. Fr. Dec.–March. Sub-deciduous and renews its leaves in May.

The stem attains 2–4 ft. girth, often deeply fluted with nearly smooth brown bark. Leaves with rounded lobes more or less pubescent or hairy and with a very stout point from the sinus. Corymbs often panicled, villously tomentose. Petals 1–1·5″ densely villous on the back.

One of the most destructive climbers in the province but fortunately of considerable value. The bark yields a strong fibre (chop, *K.*; lamaklar, *S.*) used for ropes. The leaves are used as plates (kalu, *K*) and cups (pu, *K*). The pods are known as lama in *Kol*, in *Santal* the small-seeded variety being *cihri lamak*, and the large-seeded variety *dhalka lamak*. These pods are opened by means of heat which, to avoid carriage of the husks, is often applied inside the forest and is a fruitful source of forest fires. The seeds are an important article of food. The bark contains a quantity of tannin, but the mucilage makes its extraction difficult.

9. **B. anguina,** *Roxb.*

A woody cirrhose climber with peculiar compressed stems alternately convex and concave on the flexures. Branchlets very smooth terete. L. densely tomentose when young, adult thin glabrous 2–5″ with two very long acuminate lobes or lobes short, and on old plants leaves often quite entire rounded and cuspidate. Fls. very small white ·2–·25″ diam. racemed in lax terminal pubescent panicles. Pod 1–1·8″ long ellipsoid 1–2-seeded glabrous.

Ramnagar Hills, N. Champaran! Fl. Oct. Fr. Feb.–March.

Tendrils persistent simple or with two very symmetrically opposed coils. L. 7–11-nerved often as broad as long. Racemes long and slender. Calyx 5-toothed. Pet. obovate. St. 3. Ovary glabrous, stipitate.

5. AMHERSTIA, *Wall.*

Amherstia nobilis, *Wall.*, is a well-known garden tree in the more humid parts (*e.g.* Cuttack). It has a broad dark green but low crown of large even pinnate leaves and long acuminate leaflets. The flowers are very large and showy in long pendulous racemes on long pedicels which have a pair of bright scarlet bracteoles at their apex. Sepals 4. Petals only 3 developed, the upper very broad 2″ long and broad scarlet and yellow with a long tube, lateral wing-like narrower. Fl. May–June.

6. TAMARINDUS, *L.* Tamarind.

1. **T. indica,** *L.* Jojo, *K.*; Jojos, *S.*; Amli, Inli, *H.*; Tetul, Tentuli, *Beng.*, *Or.*; Tetar, *Kharw.*

A very large and very handsome tree with even-pinnate leaves with 10–20 prs. of small close linear oblong leaflets about ·5″ long and small red and yellow flowers in lax racemes. Calyx-tube turbinate, sepals lanceolate, imbricate, two lowest connate. Corolla with only the three upper petals developed, two lower reduced to filamentous scales. Stamens only 3 developed, monadelphous below, the sheath bearing 3–4 bristles (staminodes), anthers large versatile. Ovary stipitate, stipes adnate to hypanthium. Pod curved linear, somewhat compressed thick with thin crustaceous epicarp and thick pulpy mesocarp, indehiscent.

Commonly grown in villages and sometimes found in the forest on old deserted village sites. Naturalised among granite rocks near Kuru, etc., and it would

probably become so elsewhere but it suffers much from fires. Fl. usually April–June (but also seen in flower in October). Fr. Dec.–Feb. Evergreen. Supposed to be native of Africa.

It is easily grown from seed. The young plants have persistent linear-lanceolate stipules ·5″ long, pubescent shoots and leaflets ·75″ long.

The tamarind must be of exceedingly ancient introduction and it has two Sanscrit names, Tintidi and Amlika. The ripe fruit is regarded in native practice as refrigerant, digestive, carminative and laxative and useful in intoxication caused by alcohol or datura (*Materia Medica of the Hindus*). Hamilton speaks of the tree being very large and abundant among the ruins of Gaur.

7. SARACA, *L.*

Trees with even-pinnate glabrous coriaceous leaves. Inflorescence showy with coloured bracts and calyx, flowers in sessile corymbose lateral panicles. Hypanthium long cylindrical, sepals on the terminal disc, 4, oblong, resembling a zygomorphic corolla, the true corolla absent. Stamens 3–8 with long coloured filaments and versatile anthers. Ovary long-stipitate, many-ovuled. Pod flat dehiscent, coriaceous. Seeds exalbuminous.

1. **S. indica,** *L.* Husangid-ba, Usangid-ba, *K.*; Asoka, *Beng.*

A strikingly beautiful tree when in flower, with dense corymbs 3–4″ broad of a brilliant orange-scarlet, each flower with scarlet exserted stamens. The flowers are well set off by the dark-green leaves of 3–6 pairs of large oblong or oblong-lanceolate acute or acuminate leaflets which attain 9″ by 2·5″.

Along streams in the Ramnagar Hills, Champaran! Valleys of Singbhum especially in the ravines of Porahat! Bolah Reserve, Keonjhur, *Grieve*! Mayurbhanj, elev. 3000 ft. along streams! Arang Reserve, Angul! Southern Range, Puri, frequent! Fl. March–April. Fr. Sept. and seeds germinate in Dec. Evergreen. New leaves in purple drooping clusters appear at intervals.

Rarely exceeding 30 ft. with a low dense crown. Leaves sub-sessile, leaflets on some leaves only 2–3″ long and lanceolate. Corymbs often sub-terminal on short special branchlets together with a single leaf, bracts sub-persistent ascending short ovate-acuminate, ciliate, and bracteoles similar, coloured. Sepals ·25–·5″, tube 1–1·3″. Pod 6–8″ by 1–1·6″ slightly oblique both ends.

The tree is often cultivated. *Roxburgh* says "when in full blossom, I do not think the whole vegetable kingdom affords a more beautiful object." In my opinion, however, it requires to be seen in nature, along some woodland stream, to appear at its best.

8. COLVILLEA, *Boj.*

1. **C. racemosa,** *Boj.*

An ornamental tree occasionally seen in gardens, introduced from Madagascar (teste *Taubert*). It grows to a moderate size and has handsome 2-pinnate leaves with very small linear leaflets, bears large drooping dense sub-paniculate racemes of bright orange flowers in September. Rhachis of racemes thickened. Bracts coloured caducous. Hypanthium very short bulged, with 5 sepals, 4 more or less connate, the fifth and lowest free. Uppermost petal very broad, lowest narrow. Stamens 10 free declinate villous below. Ovary sub-sessile free. Pod elongate straight turgid dehiscent with several seeds.

9. POINCIANA, *L.*

Trees with ample 2-pinnate leaves and numerous small leaflets. Stipules small or well-developed. Flowers showy, orange or scarlet in terminal corymbs. Hypanthium very short. Sepals 5, large subequal. Petals 5 with the uppermost different from the others.

Stamens 10 free declinate villous at base. Ovary sessile many-ovuled. Stigma truncate ciliolate. Pod woody flat straight or curved finally dehiscent. Seeds transverse, oblong.

The *Flora of Madras* has abandoned the well-known name *Poinciana* on the grounds that the species (*Poinciana pulcherrima*) for which it was originally established by *Linnæus* has since been transferred to *Cæsalpinia* (vide *Kew Bulletin*, 1920). It appears to be open to doubt whether this necessitates a change in the genus *Poinciana* as since modified and amplified and no confusion can possibly arise by retaining the old name.

1. **P. regia,** *Boj.* Syn. Delonix regia, *Raf.*; Gul Mohur (often corrupted in English to Gold-mohur), *Vern.*; Flamboyant, *Fr.*

A beautiful and well-known tree with feathery 2-pinnate leaves. When not in flower distinguishable from the many other trees with feathery 2-pinnate foliage by the pectinate stipules with finely linear segments. Petals 2″ long or more, orbicular with a very long claw, the 5th lined with red and orange. Pod 1–2 ft. long. The narrow oblong seeds have a bony testa and often take two years to germinate.

Common in Indian gardens. Fl. April–June.

2. **P. elata,** *L.* Syn. Delonix elata, *Gamble.* The yellow Gul-mohur.

A mod.-sized tree with larger leaflets and orange flowers. Bracts small simple. Pod only 6–8″.

It is planted more in southern India and is rare in our area. Its native country is doubtful. *Roxburgh* says that it is native in Coromandel.
Fl. April–May.

10. PARKINSONIA, *L.*

Trees or shrubs with sharp thorns which represent the abbreviated axis of a 2-pinnate leaf, pinnæ 2–4 relatively very long, with compressed rhachis and numerous very small leaflets. Stipules converted into prickles. Flowers yellow in lax axillary racemes. Calyx-tube short, sepals equal coriaceous. Petals 5, the uppermost broader than the rest. Stamens 10. Ovary shortly stipitate, with many ovules. Pod linear, unevenly turgid, indehiscent or tardily dehiscent. Seeds linear oblong, parallel with the axis.

1. **P. aculeata,** *L.* Bilaiti-kikar, *H.*

A small tree with 2–6 pinnæ on the shortened main axis and stipulary thorns recurved or absent. Lflts. numerous linear-oblong ·25″ or less or obsolete. Pod 1–few-seeded, acuminate or beaked, dry, moniliform, 3–6″ long, tardily dehiscent. Seeds brown ·3″.

Apparently naturalised (from America) in various parts of the province on waste ground. Banks of the Sone, Palamau! On cotton soil, S.P.! Frequent on cotton soil, Balasore!

The seed germinates in July. The cotyledons are foliaceous oblong rounded ·8″. The first leaves are pinnate with the stipules reduced to small deciduous points.

11. GLEDITSCHIA, *L.*

Trees with the axillary branchlets often converted into branched thorns. Leaves abruptly pinnate or bipinnate, sometimes in the same species. Lflts. rather small. Flowers greenish in often panicled spikes, polygamous. Calyx with 3–5 sepals. Petals 3–5

without claws, imbricate. Stamens 6–10 free. Ovary in herm. fl. free with 2–many ovules, short style, stigma terminal pubescent above. Pod short or long compressed, indehiscent or tardily 2-valved. Seeds often surrounded by pulp.

1. **G. sinensis,** *Lamk.* Syn. G. horrida, *Willd.*; Dozahk, *Vern.*; The Honey-locust.

A tree armed with formidable thorns, leaflets ovate-elliptic obtuse. Pod elongate compressed.

Either this or the next are often seen planted on railway platforms.

2. **G. macracantha,** *Desf.* Syn. G. ferox, *Desf.*? *Vern.* as above.

Similar in habit. Leaflets lanceolate rigid, about 2″ long crenate-dentate. Pod very pulpy within.

Both species are native of China. *G. sinensis* has been introduced into Europe and whether the Indian tree is the same requires further examination.

12. SCHIZOLOBIUM, *Vog.*

1. **Schizolobium excelsum,** *Vog.*

A tree rather frequent in the town of Ranchi, introduced from Brazil, and there known as *Bacurubu*. It is readily recognised by its tall slender stem with smooth bark bearing a crown of large rather feathery 2-pinnate leaves and large panicled racemes of yellow flowers in April. Hypanthium turbinate oblique with 5 subequal oblong-ovate sepals, calyx and ovary with black hairs. Petals long-clawed oval-rotund ·5–·7″ long with wavy margin. Stamens 10 declinate, uniform. Ovary stipitate with the stipes partly fused on the upper side to the hypanthium. Pod compressed obovate, dehiscent. Seed 1 enclosed in the wing-like endocarp which separates from the epicarp.

13. PELTOPHORUM, *Vogel.*

Tall trees with evenly bipinnate leaves and showy yellow flowers in axillary and terminal panicled racemes. Flower as in *Mezoneuron* but hypanthium shallow and stigma broadly peltate. Pod compressed, indehiscent, thinner and winged towards both sutures. Seeds 1–3.

1. **P. ferrugineum,** *Benth.* Syn. Cæsalpinia inermis, *Roxb.*

A large handsome dark-foliaged tree with rusty tomentose shoots and rusty panicles of showy yellow flowers. Pod oblong, about 3·5 by 1″ with the wing each side equal. Seeds usually 3, brown oblong ·4″ long.

Now frequently planted, thrives well especially in the Central Area and is often seen on railway platforms. Fl. r.s. Fr. Dec. Native of the Eastern Peninsula and Ceylon.

Leaves 6′ to 1 ft. long, pinnæ 16–20, 3–6″ long. Lflts. 20–30, close oblong, ·5–·75″. Pod closely longitudinally veined.

14. MEZONEURON, *Desf.*

Differs from *Cæsalpinia*, to which it is very closely allied, chiefly by the flat indehiscent pod broadly winged down the upper suture, also in a less degree by its very oblique and deep hypanthium with the very cucullate lowest sepal. The floral bracts are nearly or completely suppressed.

1. **M. cucullatum,** *W. & A.* Baganaha, *Th.*; Baghin janum, *S.*; Kokobotur, *K.*

A large woody glabrous shrub, scrambling or widely scandent by the numerous small black sharp prickles on branches and leaves. Leaves ample 2-pinnate with deep green shining ovate leaflets 1-3·5″ long. Flowers bright yellow or orange articulate on their pedicels in numerous panicled racemes, often from the old wood. Pod 2–4″ long, 1-seeded.

Northern Area, Champaran to Purneah! Central Area, in valleys, Singbhum, especially in the Saranda forests! Dalbhum, *Gamble*! Santal Parganas, along streams! Fl. Sept.-Feb. Fr. Feb.

Stems with large conical or oblong bosses tipped by a prickle, sometimes one foot in girth. Leaf rhachis 6–12″. Pinnæ distant 2–5 prs. Lflts. 3–5 prs. ovate to narrow elliptic. Two anterior sepals and anterior petal produced into a slipper receiving the base of the anterior filaments. Ant. pet. fleshy purple folded, deeply 2-lobed, others and usually also calyx, pedicels and rhachis yellow. Stamens 5 longer and 5 shorter but one very long and one very short, inclined, anthers bright crimson.

15. CÆSALPINIA, *L.*

Trees or shrubs often scandent and usually armed with numerous prickles and with large abruptly 2-pinnate leaves and usually showy yellow or red flowers in axillary racemes, more rarely racemes terminal and panicled. Bracts present, at least when young. Calyx-lobes imbricate, the lowest much the largest and cucullate, tube very short. Petals spreading (or erecto-patent in *C. coriaria*), usually orbicular and clawed, the posterior smallest. Stamens 10 free declinate, filaments often woolly. Ovary few-ovuled. Pod various in form, dehiscent or not, not winged (a rudimentary wing is sometimes present).

I. Trees or shrubs, not scandent. Not indigenous.
   A. Unarmed tree. Flowers small whitish . . . . 1. *coriaria.*
   B. Prickly, at least on young stems. Flowers showy.
      Tree, prickles very few. Pinnæ and leaflets 10–15 prs. . 2. *sappan.*
      Large shrub. Pinnæ 6–9 prs. . . . . . . 3. *pulcherrima.*
II. Scandent prickly shrubs.
   A. Petals broad. Pods unarmed.
      a. Lflts. 2–3 prs. on each pinna . . . . . 4. *nuga.*
      b. Lflts. 6–12 prs. on each pinna.
         Lflts. ·25–·3″. Pod thick, sub-fleshy . . . . 5. *digyna.*
         Lflts. ·5–1″. Pod dry . . . . 6. *sepiaria.*
   B. Petals narrow. Pod echinate . . . . . . 7. *crista.*

1. **C. coriaria,** *Willd.* Divi-divi, American Sumach.

A small or m.s. tree with a dense low spreading crown and pretty 2-pinnate leaves with very numerous close-set leaflets ·12–·3″ long. Pinnæ 13–17, 1–2″ long. Fls. small whitish sweet-scented panicled. Pods spirally twisted.

Introduced from Central America and often cultivated for ornament, *e. g.* Chaibassa, Santal Parganas and Koderma! Fl. May-June. Fr. Aug. Evergreen.

It was originally introduced for tanning purposes but does not seem to be used in the province. The seed germinates well in about a week after sowing but it is probably not worth growing on a large scale, other more easily accessible materials being as rich in tannin as the pods of Divi-divi.

2. **C. sappan,** *L.* Bakam, *Beng.*; Patang, *H.*

A small tree with small and few or sometimes no prickles. Pinnæ

8–12 prs. Leaflets close sessile ·5–·75″ oblong oblique or falcate, 10–20 prs. Fls. yellow, the racemes panicled. Pod 3–4″ by 1·5″ wider and truncate at apex which is prominently beaked, polished, indehiscent. Seeds 3–4.

Planted at Ranchi and Hazaribagh! Fl. r.s.

The wood yields a red dye not, I believe, now used in the province. It is allied to the Logwood (*Hæmatoxylon campechianum*) of Central America, but the dye is Brasilin and in Logwood Hæmatoxylin. Before the advent of the aniline dyes *sappan* is said to have been much used as a dye for cotton fabrics. It is a powerful astringent (*Nadkarni*).

3. **C. pulcherrima,** *Swartz.* Krishnacharan, Gultorah, *Vern.*; Peacock flower; Barbadoes Pride. Syn. Poinciana pulcherrima, *L.*

A handsome much-branched shrub, but getting straggly and untidy when old. Upper branches often without thorns. Leaf rhachis smooth glossy 7–11″ long with 6–9 prs. of pinnæ. Lflts. on median pinnæ about 8–10 prs., median about ·7″ long, glabrous, broadly oblong, emarginate and apiculate. Flowers scarlet or yellow in elongate axillary and terminal racemes 6–12″ long or more in fruit. Pedicels 1–1·5″ long articulate above. Petals, four sub-equal transversely oblong above the long claw ·7″, the fifth with its claw longer and blade smaller and much crisped. Filaments declinate 2″ long, 5 longer than the others.

Very common in Indian gardens and sometimes running wild. Seeds sown in the r.s. will flower in the following c.s. and h.s.

The yellow variety is sometimes called var. *lutea*.

4. **C. nuga,** *Ait.* Syn. C. paniculata, *Roxb.*

A large prickly climber with prickles on the branches, at the base of the pinnæ and along the rhachis of the leaves above. Pinnæ 3 prs. Lflts. usually only 2 prs. on each pinna or one pair and an odd, elliptic- or ovate-lanceolate, shortly obtusely acuminate or acute, ·7–1·5″ rarely 2″ long, coriaceous with very indistinct venation. Fls. yellow, fragrant in panicled racemes; calyx about ·3″ and petals not much exserted, filaments densely woolly below. Pod compressed woody, obliquely broadly elliptic sharply cuspidate, about 2″ long only without the cusp and short stipes and 1·2–1·4″ broad with one, very rarely two, large brown flattened ellipsoid seed.

Tidal Forests of Orissa! Fl. Jan.–April. Fr. May.

In the Himalayan Journals *Sir J. D. Hooker*, speaking of that part of the Grand Trunk Road not far from Parasnath, writes: "On the way I found the *C. paniculata*, a magnificent climber, festooning the trees with its dark glossy foliage and gorgeous racemes of orange blossoms." There is a doubt as to what this passage refers but I believe it to have been *Mezoneuron cucullata*, which in foliage much resembles *C. nuga*. It could scarcely have been *C. nuga*.

5. **C. digyna,** *Rottl.* Umul-kuchi, *Beng.*; Hainsa, *Th.*; Gilo, *Or.*; Tari, *Or.*? *Tari* appears to be the trade name of the pods. *Teri* in Assam.

A large much branched scrambling shrub copiously armed with recurved prickles. Leaf rhachis 5–8″ or up to 11″ long, with geminate prickles at each pair of pinnæ, minutely pubescent or fulvous hairy. Pinnæ 8–10 or up to 12 prs., ·75–2·5″ long, swollen at base. Lflts. 7–10 or up to 12 prs. on the median pinnæ, ·25–·4″ rarely ·5″ long,

close oblong. Fls. bright pale yellow ·7″ diam. in copious supra-axillary glabrescent racemes 3–8″ long, pedicels slender spreading, ·7–1·25″ with very oblique persistent spreading truncate calyx-tube, sepals lanceolate ·2″ and anterior ·4″, soon deciduous. Petals orbicular, posterior smaller reflexed. Pod 1–2″ long, oblong thick fleshy shortly stipitate crowned by the long style, 1–4-seeded. Fruiting pedicels slender.

In the damper districts. Champaran, near streams in the Ramnagar Hills! Purneah and the northern Santal Parganas! Mayurbhanj! Bonai, *Cooper*! Puri, but not abundant! Angul, fairly common in places! Narsingpur! Fl. July–Oct. Fr. Feb.–April. Evergreen.

Usually very dense. Branches shining, lower prickles ·5″ straight and sharp, upper ·1–·2″ recurved and those on leaf rhachis small. Lflts. pale beneath with rounded tip and sub-cordate oblique base, minutely appressed hairy beneath and puberulous above, becoming nearly glabrous with age. Racemes often curved, glabrescent, bracts almost obsolete. Filaments far exserted woolly below. Calyx glabrous. The young pod shows signs of a wing. Seeds roundish smooth dark brown ·4–·5″ diam. with very hard testa.

The pods are said to contain as much tannin as the American Sumach and leases have been asked for. The plant is, however, far more abundant towards Assam and Burmah.

Seed obtained from Burmah, sown in July, germinated at Sambalpur after 25 days (*Mudaliar*).

6. **C. sepiaria,** *Roxb.* Uri, Relu, Kando, *H.*; Gilo, *Or.*

An extensive shrub rambling or climbing by means of the recurved prickles on the stems and leaf rhachis. Branchlets and leaf rhachides and panicle rusty pubescent or sub-tomentose. Leaf rhachis about 12″ long with geminate prickles between as well as at base of pinnæ. Pinnæ 5–10 prs., usually 1–2″ apart, 3–5″ long. Lflts. 6–12 prs., ·5–1″ long or some only ·3″ long, broadly oblong, close, rounded or retuse both ends, puberulous both sides or nearly glabrous above. Fls. showy bright sulphur yellow ·75–·9″ diam. in long simple racemes 6–12″ long which are terminal or in a vertical supra-axillary series of which the uppermost is the oldest. Pod oblong dry compressed 3–3·5″ long tipped with the straight hardened style which is ·5–·75″ long. Fruiting pedicels stout, woody.

Occasional. Gangpur, near the Brahmini river! Ranchi, planted not far from the Mahadeo Temple and occasional in gardens and hedges! Fl. Dec.–May. Fr. old ripe pods have been found by me both in September and June and unripe ones in February. I am not sure to which flowering months they relate as they remain long on the plant.

Branchlets sometimes 5-angled. Stipules semi-sagittate caducous. Young racemes with deciduous lanceolate recurved bracts ·3″ long. The small petal usually with red lines. Lower part of filaments densely woolly. Pod very tardily dehiscent.

7. **C. crista,** *L.* Syn. C. Bonducella, *Fleming*; Bagni, S.; Katkaranj, *H.*; Nata, *Beng.*; The Fever-nut.

An extensive climbing or scrambling shrub covered with short straight prickles, those on the leaf-rhachis reflexed. Branchlets fulvous-hairy. Leaves ample with large persistent compound or pinnatifid foliaceous stipules. Pinnæ 6–8 prs. and leaflets about 8 prs. oblong or ovate-oblong ·5–1″ by ·5″. Fls. pale yellow ·5 by ·75″ diam. in simple usually supra axillary very elongate racemes, the lower flowers only fertile. Young pods softly echinate, old broad-oblong prickly, 2–3″ long, dehiscent, 1–2-seeded.

Usually in hedges in the open. Champaran! Gaya! Ranchi! Santal P., frequent! Puri! Sambalpur! Fl. Aug.–Oct. Fr. Dec.–April. Evergreen.

Lflts. not contiguous, slightly downy beneath, with obtuse mucronate tip. Bracts long linear reflexed over the buds ·6–·75″ long, deciduous. The small erect petal marked with orange. Seeds large round grey ·75″ diam. with an exceedingly hard testa.

The seeds, Putikaranja in Sanskrit and Natakaranja in Bengali, are said to resemble in properties those of *Pongamia* (*Dutt*). The seeds and the root bark are largely used as antiperiodic and febrifuge in fevers. *Roxburgh* says the seed is a powerful tonic; *Nadkarni* that the powdered seed acts as a tonic in dyspepsia, and that the same smoked in a hucqua is said to cure colic; other uses are also given in *Indian Plants and Drugs* by that author.

I have found the seed germinates more quickly if the testa is rasped. The germination is hypogeal.

FAM. 55. MIMOSACEÆ (Leguminosæ).

Trees or shrubs, rarely (*Mimosa pudica*) undershrubs, with 2-pinnate leaves (rarely main pinnæ digitate). Pinnæ and leaflets sometimes reduced to one pair or (in some exotic *Acaciæ*) absent and the rhachis developed as a phyllode. Flowers small regular, collected into spikes or heads with usually prominent stamens but small perianth. Calyx tubular or campanulate, truncate or valvately toothed or lobed, sometimes minute. Petals valvate, free or more or less connate into a tubular or funnel-shaped corolla (gamopetalous) hypogynous or perigynous. Stamens as many or twice as many as the petals or numerous, hypogynous to perigynous, free or monadelphous sometime adnate to the base of the corolla. Ovary 1-carpellary free from the hypanthium, 2–many-ovuled. Fruit a dehiscent or indehiscent dry or sub-succulent pod, very rarely breaking up inside the sutures into one-seeded joints.

Germination in those species examined by me is epigeal in most, but sometimes hypogeal as in *Entada*. The first true leaves are often at once bi-pinnate.

I. Stamens definite, usually 10 (*Mimoseæ*).
 A. Flowers spicate. Anthers apiculate with a small gland in bud.
  Large climber with tendrils and immense pods . . . 1. *Entada*.
  Unarmed tree with ample leaves . . . . . . 2. *Adenanthera*.
  Small thorny tree. Fls. polygamous, similar . . . 3. *Prosopis*.
  Small thorny tree. Fls. dissimilar, spikes parti-coloured 4. *Dichrostachys*.
 B. Flowers in globose or oblong ovoid heads.
  1. Anthers apiculate glandular. Pinnæ only 2 . . . 5. *Xylia*.
  2. Anthers not gland-tipped. Pinnæ several.
   a. St. monadelphous. Sepals imbricate . . . . 6. *Parkia*.
   b. St. free Sepals valvate.
  Unarmed. Pod not jointed . . . . 7. *Leucæna*.
  Prickly. Pod breaking into joints when ripe . . . 8. *Mimosa*.
II. Stamens indefinite (*Acacieæ*)
 A. Stamens free.
  Usually spiny or prickly trees or shrubs . . . . 9. *Acacia*.
 B. Stamens monadelphous. Usually unarmed trees.
  Pod thin flat . . . . 10. *Albizzia*.
  Pod circinate, dry. Sometimes prickly trees . . 11. *Pithecolobium*.
  Pod straight, flattish, rather succulent. . . . . 12. *Enterolobium*.

1. ENTADA, *Adans*. (Pusaetha, *L*.)

Woody, sometimes immense, climbers with 2-pinnate leaves, uppermost pinnæ (or all in the seedling) sometimes converted into tendrils, leaflets often large and few-paired. Stipules small, bristle-like.

Flowers 5-merous small in slender single or fascicled spikes which are often panicled towards the ends of the leafless branches. Calyx campanulate, very shortly toothed. Petals free or slightly connate. St. 10 free, exserted. Ovary sub-sessile with many ovules. Pod compressed, in our species very large and woody, with thickened sutures and breaking up within them into large 1-seeded joints. Endocarp enclosing the seed and separating from the epicarp. Seeds large compressed exalbuminous.

1. E. **scandens,** *Benth.* Syn. Pusaetha scandens, *L.*; Karu, *K.*; Kari, *Kharw.*; Bidhanta, *S.*; Gila, Gilo, *Beng., Or.*; Osta, Arsi, *Or.* (teste *Cooper*); Saruni, *Vern.*

An immense woody climber with the 2-pinnate leaves usually ending in a point or two-fid tendril, pinnæ only two pairs often ending in an abortive leaflet. Lflts. 2–4 prs., terminal leaflet 2–3″ long, others shorter towards the base of pinnæ. Spikes of green or cream-coloured fls 4–9″ long, pubescent, often extra-axillary. Pod the largest of the family in India, often 2 ft. long, large chestnut-coloured seeds discoid 1·5–2″ diam.

Throughout the area, but not common except in the damper high forests. Purneah! Santal P.! Singbhum, valleys! Palamau, Haslett! Mayurbhanj, elev. 3000 ft.! Puri Mals, common! Fl. April. Fr. March–May of the following year. Deciduous March–April.

Attains 3–4 ft. girth, stems often with cork-screw-like flanges. Bark brown, blaze red or pink and very fibrous in old stems, wood without the large pores usually common in climbers. Lflts narrow-elliptic to obovate, with many fine sec. n., apex emarginate even when shortly acuminate, above glossy. Calyx ·12″. Corolla lobes valvate ·17″, oblong-lanceolate acute. Bracts minute linear.

The powdered seed mixed with ghee is eaten as an anodyne during parturition. The seeds are often worked up into small boxes and ornaments.

The germination is hypogeal, and the seedling concentrates all its energy in quickly getting up through the bushes to the light so that all the leaves are entirely converted into slender tendrils, the rhachis ending in a mucro. These tendrils gyrate very fast, describing many complete circles in the course of the day.

2. ADENANTHERA.

1. **Adenanthera pavonina,** *L.* Ranjan, Rakto-kanchan, *Beng.*

A large handsome tree but sometimes flowering as a shrub is sometimes found in gardens, as at Dumka and Ranchi. It has ample 2-pinnate leaves with 8–12 distant pinnæ, each with 12 or more alternate oblong leaflets ·75–1·25″ long. The flowers look somewhat like those of *Entada*, being small and yellowish in axillary and panicled spiciform racemes 2–6″ long, each with 10 free stamens as long as the corolla. Pod 6–9″ by ·5″ falcate, with about 10 bright scarlet, rarely yellow-brown seeds, each of which are said to weigh 4 grains, and are used as weights and ornaments.

3. PROSOPIS, *L.*

Trees usually with axillary or paired thorns or stipulary and scattered prickles, rarely unarmed, with evenly 2-pinnate leaves of a few pairs of pinnæ and many narrow coriaceous leaflets, glands often present on the rhachis. Fls small, in narrow spikes or spiciform racemes without bracts and bracteoles. Calyx campanulate with short teeth. Petals 5 ligulate connate to the middle or later free. Stamens 10 free, slightly exserted, anthers with an apical gland. A

raised disc sometimes present. Ovary stipitate, many-ovuled. Pod flat or turgid with a thick spongy mesocarp, septate, often torulose. Seeds ovoid, compressed.

1. **P. spicigera,** *L.* Jhand, *H.*; Shami, *Beng.*

A small thorny tree with rather glaucous foliage. Leaves with 2 prs. of pinnæ only, each with 7–10 prs. of ligulate leaflets ·25–·5″ long with an ascending cusp. Spikes 2–3″. Corolla under ·1″. Pod straight cylindric torulose, 4–8″ long with 10–15 seeds.

A specimen in the Calcutta Herbarium is described as from "Bihar" but it is very rare there and probably only in the driest parts. In districts where the tree is abundant the pods form a valuable food for cattle, camels and goats.

4. DICHROSTACHYS, *DC.*

Small trees or shrubs with the branchlets often ending in thorns. L. 2-pinnate with several pinnæ and many small or minute ligulate leaflets, stipules present, stipellæ 0. Spikes parti-coloured with dimorphous minute flowers, the upper yellow and 2-sexual, the lower pink and neuter bearing long filiform staminodes. Calyx minute. Corolla oblong with 5 ligulate petals connate towards the base. Stamens free, 10, anthers gland-tipped. Ovary many-ovuled. Pod narrow compressed becoming spiral or irregularly bent and depressed between the seeds, not septate.

1. **D. cinerea,** *W. & A.* Vurtuli, *H.*

A large branched shrub or small tree looking like an *Acacia* when not in flower. Twigs mostly ending in a thorn. Easily recognised by its pretty tassel-like stalked heads of flowers, the lower 1–2″ with staminodes ·5″ long being a bright rose colour, the upper usually shorter portion yellow with the stamens more shortly exserted and antheriferous. Pods curled and twisted 3–4″ long in clusters.

Only found on black cotton soil in the extreme south of the province! Puri! In flower or fruit most of the year round. Seed has been collected October and November.

Bark grey. The habit is very characteristic, the numerous branches being armed with short lateral and terminal straight thorns and the leaves on the thorns and small nodose tubercles which are covered with what are apparently the bases of persistent stipules. L. rhachis only 1·5–3″ long pubescent with 3–12 prs. short pinnæ and numerous leaflets only ·05–·1″ long. Seeds 6–10.

5. XYLIA, *Benth.*

Tree with 2-pinnate leaves; pinnæ only one pair with large leaflets. Flowers small tubular-campanulate sessile in dense globose peduncled heads, often imperfect and 1-sexual, peduncles mostly from the axils of fallen leaves, and clustered on the new shoots before the leaves develop, often paired from the axils of caducous linear scales. Calyx with 5 lanceolate lobes. Petals 5 valvate. Stamens 9–10 free, exserted, with slender filaments, anthers apiculate and tipped with a caducous gland. Ovary sessile or reduced to a fulvous hairy pistillode. Ovules many. Pod large woody scarcely septate, seeds oblong compressed.

1. **X. xylocarpa,** *Taub.* Syn. X. dolabriformis, *Benth.*; Inga xylocarpa, *DC.*; Kongra, *Or.*; Suria, *H.*; Tangen, *Khond* (Kalahandi).

Usually a small tree in our province but attains 6 ft. girth in places, with brown tomentose thick branchlets. Petiole together with main rhachis 2–5″, sec. rachides 4–13″ with normally 5–6 prs. of leaflets, rarely 2–3 or 7 prs. on some leaves, basal usually ovate upper oblong, length 2–8″ with 7–12 fine oblique sec. n. Glands 4–5 on rhachis, between the upper leaflets. Peduncles 1–2″. Heads ·5–·75 diam. (without the stamens). Corolla one and a half times as long as the calyx. Pods flat woody somewhat shoe-shaped, 6″ long and 2″ broad towards base and about 1·25″ broad towards apex, the gibbous base contracted upward to the stipes. Seeds brown broad-oblong ·5–·6″ about 10, in depressions of the valves.

Frequent and often kept as standards in the Puri forests! Mayurbhanj, up to 1000 ft., attaining large size! Kalahandi! Narsingpur, attains 6 ft. girth in the high valley of Nayagarh! Fl. April–May when leafless. Fr. Feb.–April.

It is the well-known Pyingado or Iron-wood of Burmah but the small trees as usually found do not appear to be of much value.

6. PARKIA, *R. Br.*

Large handsome trees with ample 2-pinnate leaves often with glands on the petiole, and very many small leaflets. Flowers in dense heads on long peduncles, each flower narrow-tubular subtended by a narrow bract with a clavate or spoon-shaped tip. Stamens 10 exserted, connate below, anthers eglandular. Ovary stipitate. Pod large flat narrow many-seeded.

1. **P. biglandulosa,** *W. & A.* The Drum-stick tree.

A very handsome tree with large feathery leaves 12–20″ long, petiole with 2 glands. Heads of flowers with an offensive smell on long rusty peduncles 6″ long, deep brown in bud and constricted about one-third way up. Fls. about ·5″ long.

Often planted, *e.g.* in forest compound at Chaibassa. Fl. Feb. The trees at Chaibassa averaged 54·5 ft. in height and girth 43·9″ in 15 years. They are therefore remarkably quick-growing.

7. LEUCÆNA, *Benth.*

Trees, or flowering as large shrubs. L. 2-pinnate. Flowers in dense globose heads which are often fascicled or panicled. Stamens 10 free much exserted without gland-tips. Ovary stipitate. Pod flat coriaceous many-seeded.

1. **L. glauca,** *Benth.*

A large shrub or small tree. L. with 4-8 prs. of pinnæ each with 10–15 prs. of linear glaucous lflts. ·3–·5″ long. Fls. white in heads 1″ diam. Petals twice the calyx-tube. Pods about 6″, very numerous, with flat transverse ovate seeds.

Commonly planted and often self-sown in moist situations. Fl. May–Aug.

8. MIMOSA, *L.*

More or less prickly shrubs or undershrubs with digitate-pinnate or 2-pinnate leaves and numerous small, more or less sensitive

leaflets, stipules and stipellæ small. Fls. very small in dense globose heads, mostly 4-merous. Calyx campanulate, teeth small. Stamens as many or twice as many as the petals, much exserted. Pod flat dry, breaking up into 1-seeded joints which separate from the continuous slender sutures.

A. Pinnæ digitate. Stamens as many as petals . . . . . 1. *pudica.*
B. Pinnæ pinnately arranged. Stamens diplostemonous.
  1. Leaves much over 1″ long.
    Pinnæ 8–12 prs., lflts. 16–20 prs. ·2–·3″ long . . . . 2. *himalayana*
    Pinnæ 4–6 prs., lflts. 10–15 prs. ·4–·7″ long . . . . 3. *rubicaulis.*
    Pinnæ 5–7 prs., lflts. 7–8 prs. Pod sutures aculeate . . 4. *Prainiana.*
  2. Leaves under 1″ long.
    Pinnæ 3–5 prs. Pod very prickly . . . . 5. *hamata.*

The Indian species of *Mimosa* have been revised by *Gamble* in *Kew Bulletin* No. 1, 1920. In this the species usually hitherto known as *M. rubicaulis* and *M. hamata* have been split up. My collections and those at Kew only show the new *M. himalayana* from our area but these are so few that I have added the typical *M. rubicaulis* and *M. Prainiana* to the Key in case they should hereafter be found, and also shown *M. hamata* for comparison.

1. **M. pudica,** *L.* Lajalu, lajwati, *H.*; Kajak, *Beng.*; Lajkuri, *Or.*; The Sensitive Plant.

A well-known small undershrub with weakly-prickly stems and compound spreading long-petioled leaves, with 4 digitately arranged pinnæ 1–2·3″ long, leaflets linear ·3–·4″ rarely ·5″ long, stipules pectinately ciliate. Peduncles 1–2 axillary with pretty pink heads of flowers. Bracteoles to the male flowers minute subulate or 0, to the hermaphrodite flowers stiff subulate pectinate. Fls. ·03″ long without the stamens which are about 4-times as long. St. 4. Pod with weak prickles on the sutures.

Common in the damper districts in open places, waysides, etc., or in partial shade. In the dryer districts is chiefly confined to damp sandy ground. It occurs inside the Lachmidungri forest near streams in Sambalpur and is thoroughly naturalised. Originally from tropical America (Brazil). Fl., Fr. r.s. and c.s., also found in fruit in Puri in March.

On the irritability of the Sensitive Plant see *Sachs, Physiology of Plants,* English edition, p. 644.

2. **M. himalayana,** *Gamble.* Syn. M. rubicaulis, *F.B.I.* (in part); Shiah-kanta, *H.*; Kundaru, *K.*; Sega-janum, *S.*; Khirkichi-kanta, *Or.*

An erect or sub-erect very prickly weak shrub 6–10 ft. high with many stems. Branches angular, densely tomentosely pubescent when young, with close scattered slightly curved prickles. Leaf rhachis 4·5–8″ very prickly, with 8–12 prs. of pinnæ ·7–1·5″ long. Lflts. 16–20 prs. or only 10 on the basal pinnæ ·15–·27″ oblong. Fls. pink, in heads about ·5″ diam. on peduncles ·7–1″ long which are 2–4-nate, axillary and in long thyrsiform racemes in the axils of undeveloped leaves with filiform stipules ·2–·25″ long. Pod linear-oblong curved (or straight, *teste Gamble*), 2–3″ long, 4–10-jointed and -seeded, glabrous with attenuate base and apiculate apex tipped by the long style. Sutures slightly aculeate or unarmed.

Very common in low jungles, forest glades and sometimes in hedges. Purneah, abundant! Soane River, Bihar (with aculeate pods), *J.D.H.*! Chota Nagpur, frequent! This, or *one of the forms of the M. rubicaulis, F.B.I.*, occurs throughout the area, but whether the Khirkichi-kanta of Puri, Angul and Sambalpur is

M. himalayana remains to be ascertained, as it was merely noted by me as *M. rubicaulis* (*sensu F.B.I.*). Fl. r.s. to Oct. Fr. Jan.–April.

Lflts. with obtuse or subacute mucronate tip and semi-rectangular base, hairy beneath, mid-rib nearer the upper margin, sec. n. faint, about 5, looping. Bracteoles among the flowers minute clavate pubescent. Calyx campanulate, 1 mm. long, glabrous. Corolla funnel-shaped, 2·5 mm. long, lobes 4 oblong as long as the tube. St. 8, long-exsert. Ovary glabrous.

In Angul "Khirkichi" is said to be used for gunpowder charcoal. In Manbhum the powdered root is given for vomiting arising from weakness, *Campbell*.

9. ACACIA, *Willd.*

Erect or climbing, usually armed trees or shrubs with either 2-pinnate leaves or the leaves transformed into green variously shaped phyllodes. Leaflets when present usually small. Stipules sometimes transformed into spines, stipellæ 0. Flowers small in heads or spikes, usually 5-merous, sometimes polygamous, each subtended by a bract. Calyx campanulate, toothed. Corolla free from the calyx-tube, more or less gamopetalous. Stamens many, free or connate with one another and to corolla at the base only. Pod usually flat and dry, sometimes moniliform and turgid but never breaking into joints, usually dehiscent.

The germination in species examined is epigeal, the cotyledons rather fleshy, subsessile or shortly petioled, ovate to oblong. There is a curious disc-like growth in some cases separating the hypocotyledonary axis from the root. The stipules are from the first often converted into spines.

§. Leaves not converted into phyllodes.
- I. Flowers in globose heads.
  - A. Armature stipular in origin and therefore usually geminate, spines straight.
    - 1. Heads axillary, yellow or orange.
      - Shrubby. Pinnæ 4–8 prs. Pod 2–3″, turgid . . 1. *Farnesiana*.
      - Arboreous. Pinnæ 3–9 prs., ·5–2″ long. Pod moniliform . . . . 2. *arabica*.
      - Pinnæ 4–6 prs., up to ·5″ long only. Pod even . 3. *eburnea*.
      - Pinnæ 7–14 prs., ·5–1·5″ long, tomentose . . . 4. *tomentosa*.
    - 2. Heads panicled, nearly white . . . . . . 5. *leucophlœa*.
  - B. Armature not stipular. Usually of scattered curved prickles.
    [Heads 1–7-nate appearing panicled (exc. *concinna*) from the leaves in the axils of which they arise being undeveloped at the time of flowering.]
    - 1. Small erect tree.
      - Pinnæ 16–20 prs. extending almost to base of rhachis. Lflts. ·25–·5″ long . . . . 6. *Donaldi*.
    - 2. Climbers or scrambling woody shrubs, rarely suberect.
      - *a*. Pod thin.
        - Pinnæ 8–20 prs. Lflts. ·2–·35″ long linear . . 7. *pennata*.
        - Pinnæ 8–20 prs. Lflts. ·15–·2″ long linear . . 8. *canescens*.
        - Pinnæ 12–20 prs. Lflts. ·25–·3″ oblong, hairy . 9. *torta*.
        - Pinnæ 6–8 prs. Lflts. ·3–·7″ linear-oblong . . 10. *cæsia*.
      - *b*. Pod thick.
        - Pinnæ 3–6 prs. Lflts. ·4–·6″ . . . . . 11. *concinna*.
- II. Trees. Flowers in spikes. Spines usually stipular, short and curved.
  - A. Lflts. under ·5″ long.
    - Pinnæ 7–24 prs. Bark very dark . . . . . 12. *catechu*.
    - Pinnæ 10–20 prs. Bark very light . . . . . 13. *suma*.
    - Pinnæ 3–5 prs. . . . . 14. *ferruginea*.
  - B. Lflts. ·75–1·5″ long . . . . 15. *lenticularis*.

§. Leaves converted into phyllodes (introduced species).
- Phyllodes 4–7″ long. Pod spiral . . . . . 16. *auriculæformis*.

1. **A. Farneesiana,** *Willd.* Dei-babul, Bilaiti-babul, Gand-babul, *H.*; Gabur, *S.*; Kapur, *Or.*; Guyababla, *Beng.*

A shrub or small tree 12–20 ft. with 4–8 prs. of short pinnæ, and 10–20 prs. of minute crowded leaflets ·07–·15″ long. The branches bear small usually slender stipular spines ·12–·7″ long. Heads of deep orange deliciously fragrant flowers ·6″ diam. on peduncles 1–1·5″, usually clustered on abbreviated shoots from the axils of fallen leaves, also axillary. Pod 2–3″ long, brown, turgid, ·5–·6″ thick, curved, not dehiscent. Seeds dark-brown, more or less oval, ·25″ scarcely compressed.

Cultivated in gardens throughout the province and often self-sown. It is a native of the West Indies. Fl. chiefly Sept.-Feb. Fruits may be found most of the year, ripen April and fall in the monsoon.

Branchlets often zigzag, lenticellate. Leaf rhachis with short petiole pubescent, often ending in a spine, a gland often present above the petiole, pinnæ ·5–1″ rarely 1·5″ long.

If pruned it makes a very beautiful garden shrub covered with innumerable yellow fragrant heads which under the misnomer of "Cassia flowers" are used in perfumery. The roots have a smell of garlic and with the pods are said to be rich in tannin.

Cotyledons oblong.

2. **A. arabica,** *Willd.* Babla, Babur, Gabla (*teste Draper*), *K.*, *S.*; Babul, Kikar, *H.*; Bambur (in Sambalpur).

A tree attaining 4·5 ft. girth, but often flowering as a shrub, with long straight white (stipular) spines ·25–2″ long on the branches. Leaves with 3–6 (seldom up to 9) prs. of pinnæ ·5–2″ long, each with 10–20 prs. of leaflets ·12–·25″ long. Leaf rhachis with a cup-shaped gland at the base of the lowest and generally also of the uppermost pair of pinnæ. Heads of yellow flowers ·5″ diam. on short axillary slender fascicled peduncles with two bracts a little above the middle. Pod indehiscent whitish tomentose 3–9″ long, deeply constricted between the seeds.

The distribution is peculiar and appears to depend mainly on soil and the absence of competing species. Purneah! Dryer tracts of Behar and Tirhut, on alluvium! Other districts of the Central and Northern tracts mainly on spoil banks and railway embankments, where also it is sometimes planted. Santal Parganas, on Cotton soil! Southern Tract, common in Khendpara and Banki on Cotton soil and in parts of Puri! Sambalpur, rare, and chiefly on Cotton soil! It appears to avoid Metamorphic rocks and is absent from all the more fully stocked forest areas. Fl. Aug.-Dec. Fr. Jan.-April. Evergreen.

Bark deep brown or black deeply cracked, blaze very hard, deep brown then pink.

The wood is good and durable and valuable for agricultural implements. The Bark is very largely used for tannin in upper India but Babul-tanned bark is less suitable for further finishing in Europe than the so-called half-tans (*e.g.* tarwad). The seedling is very impatient of grass and other competition and it requires to be raised on clear soil in even-aged crops. In my experience it does not coppice, and in his paper read before the Tannin Conference *Mr. Tireman* says that "in general it does not coppice well," but other foresters speak of its coppicing. The tree produces the Indian Gum Arabic. The true Gum Arabic (*nilotica*) has not the white tomentum on the pods and the very moniliform pods have oblique joints. Drainage is said to be one of the essentials of its silviculture, yet it appears to thrive on badly drained cotton soil.

The cotyledons are ovate and very obtuse with the base somewhat auricled and bevelled. The roots like the last have an alliaceous odour. The pods are largely eaten by goats and the seed which passes is the best for germinating.

3. **A. pseudeburnea,** *Drummond* (in *Kew Herb.*). Syn. A. eburnea, *Willd.* (in part).

A shrub or small tree with long straight dark-brown spines which become white on the older branches. Leaves small 1–1·5″ with hairy rhachis ending in a spine or point and 4–6 rarely 8 prs. of small pinnæ about ·5″ long with 6–12 prs. of rigidly coriaceous greyish-green leaflets ·08–·12″ long. Peduncles about 1″ very slender grey-downy with connate bracts about the middle. Heads ·3–·4″ diam., corolla pale yellow (always ?). Pod 3–6″ long, thin, flat, straight, glabrous and shining.

Behar, *Kurz* ! There is only one specimen from Behar, and a very poor one in fruit. The species apparently just enters the province from Oudh and the North-West. Fl. Nov.–Jan.

Bark dark grey or reddish-brown. Spines ·25–2″, slender in our specimen. Branchlets hairy. Rhachis with a large gland between the uppermost pinnæ and (fide *Duthie*) between each of the two lowest pairs. Sec. rhachides also often ending in spines. Lflts. oblong about ·1″ long mucronulate. Pod ·25″ broad.

This tree appears distinct from the South Indian true *A. eburnea* in the larger number of pinnæ, more slender spines, and the yellow not purple corolla. But it is to be noted that *Roxburgh's* figure in *Pl. Coramand.* shows the leaves of *Mimosa eburnea* with 4–8 prs. of pinnæ ·25–·5″ long and corolla purple !

4. **A. tomentosa,** *Willd.*

A small tree with the twigs, leaves and spines covered with grey tomentum. Leaves 2–3·5″ long with several glands on the rhachis and 7–14 prs. of pinnæ ·5–1·5″ long, each pinna with 15–30 prs. of oblong pubescent leaflets ·1–·15″ long. Stipular spines straight grey reaching 3″ in length on the branches and stems. Heads ·5″ diam. on stout peduncles 1–1·5″ long with median bracts. Pods curved yellow-brown or reddish 4–5″ long by ·4″, flattened, slightly depressed between the seeds, pedicelled. Seeds 6–10, pale grey compressed oval ·3″ long.

On cotton soil, Puri, Southern Range ! Fl. May–June. Fr. April.

5. **A. leucophlœa,** *Willd.* Goira, Gohira, *Or.*; Gulura, Reimja (Sambalpur).

Usually a small tree but attaining 6 ft. girth with white smooth-barked branches, sometimes unarmed. Twigs and leaves tomentose. Leaves small, 1–3″* long with 6–12 prs. of pinnæ ·7–1·5″ long each with 15–30 prs. of crowded leaflets ·12–·3″ long. Flower-heads small ·2–·25″ diam., nearly white, numerous in large terminal tomentose panicles, bracts on peduncles median. Pods long linear curved, panicled, 4–8″ by ·2–·3″ tomentose.

Southern parts of the province only, chiefly on cotton soil not on metamorphic rocks. From Balasore and Cuttack to Sambalpur ! Not frequent in the better forests, where the seedlings get suppressed, though old trees may sometimes be seen. Fl. Aug.–Oct. Fr. Dec.

Lower parts of large trunks with very rough rugose bark which may turn nearly black, the upper part remaining white. Blaze light red slightly white-streaked. Rhachis with a gland sometimes at each pair of pinnæ. Seeds 8–12.

"Seasons well and takes a fine polish, strong and tough, but often eaten by

* I have no field notes on the dimensions of the leaves, and I suspect that the measurements given, taken from Herbarium material, are as usual too small, as these are usually associated with the inflorescence.

insects. An excellent fuel for locomotives," *Brandis*. It does not seem to be much used in this province. A fibre is obtained from the bark by steeping for several days and beating it. *Gamble* gives weight as about 55 lbs.

6. **A. Donaldi,** *Haines* (*Indian Forester*, Feb., 1917); Gar Khair, Burkeli, *Or*.

A small tree up to 2·5 ft. girth, very rarely sub-scandent. Branches with usually 5 lines of minute prickles, twigs finely pubescent, usually armed with short recurved prickles but stipular spines absent or rudimentary. Leaf-rhachis 3–10″ (usually 4–5·5″) with very short swollen petiole and a flattish or rudimentary gland on rhachis immediately above it and between each of the 3–4 upper pinnæ, rhachis with very small weak prickles on the lower rounded surface. Pinnæ 10–27 (usually 16–20) prs. ·3–·5″ apart and extending down the rhachis to within half an inch of base of petiole, median 1·5–2″ long with 25–40 rarely 50 prs. of linear leaflets ·25–·5″ by ·03–·05″. Pods green to pale yellow and whitish-brown, ultimately grey, rather turgid when unripe, up to ·25″ thick, base attenuate, but pedicel, if any, not exceeding ·2″.

Sambalpur, especially on the quartzites and shales of the Boropahar Range! Fl. July–Aug. Fr. Nov.–Jan.

Bark light-coloured, blaze slightly pink-streaked or pink in older trees. Foliage often fascicled, sparsely rigidly ciliolate, rhachis pubescent above, lflts. mucronate, base obtusely semi-sagittate or -hastate with oblique costa, under surface pale with microscopic hairs. Stipules ·12–·16″, fugacious. Heads white or cream coloured about ·5″ diam. on peduncles ·58–·8″ long usually 3-nate in the axils of bracts. These are really very young leaves and develop later so that the fructiferous peduncles become axillary. Calyx ·14″ almost glabrous 5-nerved with acute lobes. Corolla quite free from calyx, glabrous, length (measured from base of flower) ·17–·19″. Stamens very shortly connate at extreme base and also adnate to base of corolla. Ovary sericeous with long stipes ·08″ long.

The pods and seeds occur under two forms: (*a*) length 3–5″ by ·8–1″ with about 6 oblong brown seeds; (*b*) length 5–6″ by ·8″ with rounder darker seeds.

The germination is only sub-epigeal, the cotyledons are thick, oblong, and there is no hypocotyl but a thickening at the base of the cotyledons, a pair of 2-pinnate leaves and a stem between them arise immediately from the cotyledonary axis. The first leaves, which end in a point, bear two prs. of pinnæ and normal erect stipules.

The seeds are much punctured by one of the Bruchidæ, identified at the Forest Research Institute as a species of *Caryoborus*.

7. **A. pennata,** *Willd.* Syn. Kundaru, *K.*; Kondro-janum, *S.*; Arar, *Kharw.*; Dontari, Nali Konti, *Or*.

A large woody climber. Branches usually more or less 5-angled with lines of small prickles on the angles which sometimes persist even on the rounded stems. Leaves like those of *A. canescens* but pinnæ usually fewer, leaflets rarely 60 prs. less sensitive and more usually spreading, ·2–·35″ and "broader,"* green, glabrous or only ciliolate on the margins. Rhachis often more aculeate. Inflorescence (in my specimens) smaller, under 6″ long, peduncles thinly pubescent or nearly glabrous. Bracts subtending the flowers very small without

---

* But I cannot follow altogether the distinctions between these two species given in the *Flora of Madras*. One of these is that the leaflets of *canescens* are always acute, yet some specimens named at Kew have not only obtuse but rounded tips to the leaflets. The leaflets in *pennata* are said to be linear-oblong and those in *canescens* linear, but the *proportionate* breadth seems to me the same.

the dilated tip which usually occurs in *A. canescens*. Flowers as in *A. canescens* var. *albida*. Pod ·75–1″ broad.

Behar, Soan River, *J.D.H.*! Sikkim Tarai, and therefore probably all through the Northern Area! Fl. r.s., Fr. c.s.

In Behar specimens the median leaflets are ·17–·3″ long, with mid-rib nearer upper edge at base but nearly central at tip, the base is rounded rectangular with about 4 small nerves. Pods variable but always purple when young, 5–7″ by ·7–1·3″, suddenly obtusely acuminate or acute.

8. **A. canescens,** *Grah.* Syn. A. pennata var. canescens, *F.B.I.*; Kundaru, *K.*; Kondro-janum, *S.*; Arar, *Kharw.*; Dontari, Nali Konti, *Or.*

A large woody climber. Branches usually more or less 5-angled with 5 lines of small prickles even when old. Shoots and twigs grey- or fulvous-tomentose. Leaf rhachis without or with only very few prickles 3–8″, with a large gland between the very short swollen petiole and the pinnæ, a gland also between 2–3 of the uppermost pinnæ, rhachis permanently pubescent or glabrescent with 8–20 prs. of pinnæ the lowest of which is usually from 1·5–2″ distant from base of petiole. Pinnæ ·25–·5″ apart, 1·5–3″ long with 40–80 prs. of very small linear leaflets ·15–·2″ long permanently hoary beneath. Pod thin flat dry with strong sutures 4–6·5″ by about ·7″, deep brown or purple, margins sometimes sinuate.

In all districts, chiefly near nalas in the dryer ones. Purneah (or Sikkim Tarai)! Soane River, Shahabad and Plains of Bihar, *J.D.H.*! Gaya! Singbhum! Gangpur! Hazaribagh! Santal P.! Puri (var. *fulva*), ascending to the tops of the hills at Rajim! Fl. May–Aug., sometimes earlier in wet seasons. Fr. ripens following April.

Bark light-coloured. Blaze crimson (this may possibly be *pennata*). Lflts. with rounded apex or (in var. *fulva*) acute. Construction of inflorescence as in the last. Peduncles often 4-nate and with 1–2 linear deciduous bracts. Calyx ·08–·09″ long. Corolla (from base of flower) ·1–·12″. Seeds up to 12 black, oblong, ·4–·5″ long by ·3″.

There are two varieties, perhaps as distinct from one another as they are from *pennata*. Indeed I only keep *A. canescens* distinct from *A. pennata* to be in uniformity with the *Flora of Madras*.

Var. **albida.** Lflts. with rounded apex, glabrescent or nearly so, costa nearly central at apex. Flower quite glabrous or ovary minutely sericeous, calyx with a delicate median nerve to each sepal.

Var. **fulva.** Shoots densely rusty tomentose, indumentum more permanent, leaflets very acute with costa close to upper margin. Calyx minutely pubescent, not nerved. Ovary sericeous.

Mals of Puri only.

9. **A. torta,** *Craib* (*Kew Bulletin*, No. 9 of 1915). Syn. A. cæsia, *W. & A.*, A. Intsia var. cæsia, *F.B.I.* (As pointed out in my *Descriptive List of Trees, etc., Central Provinces*, this is not the Mimosa cæsia of Linnæus, and *Mr. Craib* has renamed it in *Kew Bulletin*, 1915, No. 9.) Same vernacular names as for A. canescens and A. pennata, also Dontari, Konti, *Or.*; Dater, *Khond* (?).

A large scrambler or climber with the stems very often channelled or 5-angled. Branches with 5 lines of prickles, young tomentose. Leaf rhachis densely pubescent or tomentose, 6–10″ long with small recurved prickles and a depressed or conical gland at base, pinnæ

12–20 prs. 3–4″ long (some only 2″ or reaching 5″), pubescent ·4–·5″ apart, lflts. oblong 30–45 prs. rigidly spreading (except in sleep) ·25–·31″ by ·1–·15″, always somewhat pubescent beneath. Heads white, copiously panicled. Pods flat dry with strong sutures, 3–5·5″ by ·6–1″ light brown, usually cuneate both ends, with a rusty tomentum when young.

Central and Southern areas, probably in all districts. Behar, *T.T.*! Monghyr, *Ham.*! Gaya! Santal P.! Chota Nagpur, all districts! Mayurbhanj! Narsingpur! Angul to Sambalpur! I am doubtful whether it occurs in Puri, where the next species has been collected. Fl. May–Sept. Fr. Jan.–March. Evergreen. Trunk attains 2·5 ft. girth with rough bark, brown blaze, on younger stems bark light-grey nearly smooth and blaze slightly pink. Wood light-brown or reddish, structure normal, falsely ringed with soft tissue in which the pores are.

NOTE.—The leaf rhachis includes that part of it usually termed the "petiole" below the pinnæ and down to the true thickened petiole.

10. **A. cæsia,** *Willd.* Syn. A. Intsia, *F.B.I.* Same vernacular names as for A. torta.

A large climbing shrub with stout 5-angled stems with minute prickles. Twigs sometimes circinate. Shoots pubescent or tomentose with sharp recurved prickles. Leaf rhachis 4–8″ long pubescent, sometimes glabrescent, aculeate, with a large linear-oblong swollen gland at the base often with free conical apex, and a large gland just below 3–4 of the uppermost pinnæ. Pinnæ 6–8 prs., 1·5–3·5″ long, rhachis at first closely pubescent or pilose, afterwards thinly so, ·5–1″ apart with a distinct short petiolule and two setaceous stipellæ above the petiolule (these are present in *A. torta*, but are more minute and hidden by the indumentum). Lflts. 8–15 prs. usually shining (often steel-blue in herbarium), obliquely oblong, sessile, mucronate, smaller ·3″, larger (on the same plant) ·7″ long by ·27″ wide, with a few fine hairs beneath when young but glabrescent. Panicles axillary and terminal, very narrow and lax up to 18″ long with the future leaves very minute and bract-like, heads 5–7-nate, red in bud, ·5–·6″ diam. Fls. white with tip of calyx and corolla often red. Bracts between flowers oblong-spathulate acute ciliate. Calyx ·08″ (or ·1″ in fresh specimens), length to tip of corolla ·1–·12″. Stamens ·25–·27″ long. Pod thin with thickened sutures, dark brown, 4·5–6″ long by ·8–1″ broad, base rounded or cuneate, stipes ·2–·25″. Seeds ·4″, dark polished brown, oval, flat.

Southern Area only, in extreme south. Puri! Angul! Fl. Sept.–Oct. Fr. April. Renews leaves as in other species at time of flowering or immediately after flowering.

I have had to describe these species at great length on account of the confusion existing in works as to their distinctive characters.

11. **A. concinna,** *DC.* Syn. A. rugata, *Ham.*; Ban-ritha, *Beng.*

A large very prickly scrambling shrub with pale-grey twigs copiously armed with hooked prickles. Leaf rhachis 3–5·5″ long pubescent with 3–6 prs. rarely up to 8 prs. of pinnæ, of which the median are about 2·5″ long with 9–15 prs. of leaflets ·4–·6″ long and ·2″ broad. Flower-heads appearing with the more or less developed leaves, not panicled but 2–4-nate in the leaf axils and below them

(scale axils), cream-coloured or pink, ·4–·5″ diam. Pods thick and fleshy, depressed between the seeds and margin often constricted, but finally dehiscent, 2·5–4″ long by ·7–1″ broad, beaked.

Throughout the area but not common. Ramnagar Hills! Purneah! Valleys in Singbhum! Puri! Angul! Fl. April–June. Fr. ripens following March. New leaves in March–April. In Purneah a sub-arboreous specimen was found.

Branchlets often nearly white. Shoots pubescent. Pinnæ ·5–1″ apart. Length of flower to tip of corolla ·11–·13″. Calyx ·087″, minutely thinly pubescent. Ovary usually glabrous or nearly so in our area.

Var. **rugata,** *F.B.I.*, is distinguished by the larger leaflets and pods and villous ovary. The *Flora of Madras* keeps *rugata, Ham.*, as a distinct species from *concinna*. I am unable to accept the validity of the distinctive characters given as my specimens have pinnæ only 3–6 prs. and an all-but glabrous ovary. The young pods in the Ramnagar specimen have very minute scattered thin hairs and the ovary may therefore have been pubescent; the leaflets are, however, those of *concinna* and the pod is only ·7″ broad.

The pod is saponaceous and used for washing.

12. **A. catechu,** *Willd.* Khair, *H.*, *S.*; Khoiru, *Or.*

A small tree with black bark, branches slender armed with geminate (stipulary) hooked spines. Pinnæ 7–24 prs. with their rhachis from ·5″ (on very small leaves) to 1·5″ long, pubescent or hairy, with 6–35 but mostly 12–20 prs. of sessile ciliate leaflets ·1–·2″ long. Fls. small white or pale yellow, crowded in pubescent spikes 2–3·5″ long, axillary on the young shoots. Fls. ·08–·1″ long excluding stamens, the corolla one-and-a-half to usually two times as long as the calyx, both pubescent or petals densely hairy, greenish with membranous margins. Ovary glabrous stipitate. Pods 2–5″ by ·6–·8″ often irregularly constricted, 4–7- rarely only 2-seeded, obtuse mucronate or beaked, base contracted into a pedicel and pubescent, above glabrescent, dehiscent.

Central and Southern Tract, usually in dry forest! Gaya! Palamau, common, and often found mixed with the Sal both on clay and sandstone! Hazaribagh, esp. on sandstone and often mixed with Sal! Manbhum! S. Parg., especially on cotton soil! Athmallik! Narsingpur! Angul! In all the Orissa States, *Cooper.*

Bark peeling off in thin vertical strips, blaze very hard vandyke-brown, then deep pink, twigs pubescent. Main rhachis 2–6″ rarely 8″ with a gland below the pinnæ and one between the uppermost 1–6 pinnæ. Peduncles sometimes paired ·5″. Stamens in 5 bundles at base of corolla with long glabrous or very sparsely hairy filaments.

A valuable wood, strong and very durable, largely used as house posts. The wood yields, by boiling the chips, the well-known Kath used for chewing with Betel and in medicine, and Catechu, used for tanning. These have for long been manufactured in Palamau, Manbhum and Hazaribagh. Kath is a valuable astringent.

The open Khair forests are largely a result of treatment by man, and where cattle and fires are kept out the Khair tends to die out, as it neither seeds nor coppices under shade—a point which has sometimes been lost sight of. The weight of the wood as given by *Gamble* is about 50–60 lbs.

The cotyledons are orbicular-oblong ·25″ long with auricled-cordate base. The first stipules are erect and normal, the first leaves with only two pinnæ.

Var. *α* **catechuoides,** *Wall.* sp.

A straighter tree than *A. catechu* and chiefly distinguished by the puberulous not pubescent rhachis and glabrous calyx and corolla.

It is more a tree of river-beds where it occurs in the sub-Himalayan tract in northern Purneah! This may also be the tree of Bettiah and Ramnagar, but the Khair of that district was not examined by me.

13. **A. suma,** *Ham.* San-kanta, *Beng.*

A tree much resembling *A. catechu* but with white bark, more flexuose branches and with the corolla not much exceeding the calyx.

Manbhum, Raganathpur, *Clarke*! Balugaon. Puri! *Gamble* says common in Orissa, but he probably refers to Orissa in its wider sense. Patna and Kalahandi, *Grieve.* Fl. Aug. Fr. Dec.

Branchlets and petioles grey-pubescent. Leaves 4–10″ long with a large gland above base of petiole. Pinnæ 10–20 prs., leaflets 20–50 prs. generally ciliate. Flower usually under ·08″ but the relative length of calyx and corolla is variable. In nearly all the specimens I have seen the calyx is not much more than half as long as the corolla, in some three-fourths or two thirds. Pods 2–5″ by ·75″ pubescent when young.

The wood is said to be similar in its properties and uses to that of *A. catechu.*

14. **A. ferruginea,** *DC.* Safed Khair, *H.*; Kanta Chira, *Or.*

A fairly straight tree 2–4 ft. girth. Branchlets pubescent with small stipulary prickles ·1–·15″ slightly curved. Leaf rhachis 1·5–2·5″ with 3–5 prs. stalked pinnæ each with 10–18 prs. lflts. Lflts. ·25–·35 glaucous, almost white when dry. Pod about 4″ up to 6·5″ long by ·8″, 4–6-seeded, upper suture margined. Spikes 3–4″.

This is also a rare tree in our area, only found by me in the Bolong Forest, Angul! It will probably also be found in Kalahandi and the Khondmals. Fl. Mar.–April. Fr. Nov.–Jan.

Bark grey, cracking into oblong pieces. Blaze light crimson or in old trees deep crimson, with thin white lines. As the tree is nearly bare of leaves at the time of flowering the spikes appear panicled.

15. **A. lenticularis,** *Ham.* Khairi, *Ur.*; Kolsa-kanta, *H.*; Balu Tentul, *Mal. P.*; Kanta Siris, *S.*

A pretty tree, 20–40 ft. high, at first sight much resembling an Albizzia or Siris, with bright green foliage and large leaflets. Pinnæ 2–4, more rarely 5 prs., 3–5″ long. Lflts. 7–12 prs. oblong or obovate-oblong sub-sessile glabrous or nearly so ·75–1·5″ by ·6″. Fls. pure white in stout dense spikes 4–5″ by ·75″ with hairy rhachis. Pod flat straight 5–9″ by 1–1·5″.

Hill forests, central and southern tracts. Hazaribagh, frequent, esp. on quartzite, on clay schists near the Damuda! Palamau, Kumandi reserve and Adhe, on banks of streams! Ranchi Ghats, common! Common about Neterhat, 3000 ft.! Porahat, Kundrugutu forests! Rajmahal Hills, not common! Kalahandi, *Grieve.* Fls. May–June. The pods seem to ripen about Oct. and Dec., but remain on the trees often till following April. Evergreen.

Attains 7·5 ft. girth in Palamau. Old bark brown-grey or dark-grey with oblong flakes and blaze deep crimson. The old trees are nearly unarmed or with straight slightly recurved stipulary compressed spines. Leaf rhachis 5–7″ glabrous or slightly hairy with a gland below the pinnæ. Lflts. margined with rounded apex and oblique base, mid-rib nearly median. Calyx slightly hairy, teeth nearly as long as tube. Petals greenish, twice the calyx.

Frost-hardy and ornamental, but the timber is said to be attacked by white ants, though very hard and strong.

16. **A. auriculæformis,** *A. Cumm.* (Benth. in *Hook. Lond. Journ.,* i, p. 377.)

A rather tall straight tree with smooth white bark, sometimes taken for a Eucalyptus. Glabrous and glaucous with slightly angular branchlets. The place of leaves is taken by large laterally

compressed falcate-oblong phyllodes 4–7″ long and ·5–1·5″ broad, narrowed both ends with 4–6 principal sub-parallel nerves sometimes confluent near the base and finer parallel intermediate occasionally anastomosing. Flowers small white in slender axillary spikes 1·5–2·5″ long, calyx broadly campanulate ·02″ long minutely toothed, petals spreading as long as the calyx. Pod hard, almost woody, much twisted in an irregular spire with the outer edge often sinuate as in some Pithecolobium.

Frequently planted as in Bankipur! Fl., Fr. at various times of the year. Native of N. Australia and Queensland.

A few other Australian phyllodineous *Acacias* are sometimes met with in gardens, but the above is the only common one. All transitions occur between phyllodes and true leaves and the seedlings of phyllodineous *Acacias* have usually normal leaves.

10. ALBIZZIA, *Duraz.*

Unarmed trees with 2-pinnate leaves. Flowers in globose heads rarely subtended by bracts on 1–5-nate peduncles which are either axillary or in the axils of rudimentary leaves which ultimately develop, rarely truly panicled and in the axils of small or large bracts. Calyx tubular or campanulate, teeth usually small. Corolla gamopetalous usually exserted and with 5 petals. Stamens many more or less connate. Ovary sessile or shortly stipitate, many-ovuled. Pod linear or linear-oblong, flat, straight, thin, indehiscent or tardily dehiscent. Seeds exalbuminous, compressed.

A. Pinnæ 1–2 prs. only. Lflts. 2–5″ long . . . . . . 1. *lucida.*
B. Pinnæ 2–6 prs. Lflts. mostly over ·75″.
  Pinnæ 3–6 prs. Lflts. 1–2·3″. Fls. sessile . . . . 2. *procera.*
  Pinnæ 2–4 prs. Lflts. ·75–2·25″. Heads axillary. Fls. pedicelled . . . . 3. *lebbek.*
  Pinnæ 2–5 prs. Lflts. ·6–1·3″. Heads panicled. Fls. sessile . 4. *odoratissima.*
C. Pinnæ mostly over 6 prs. Lflts. all under ·75″.
  Pinnæ 3–10 prs. Lflts. ·5–·75″. Fls. pedicelled . . . 5. *Thomsoni.*
  Pinnæ 6–15 prs. Lflts. ·1–·25″, costa median . . . . 6. *amara.*
  Pinnæ 12–20 prs. Lflts. ·15–·35″, costa submarginal . . 7. *stipulata.*

1. **A. lucida,** *Benth.* Gobraha, *Th.*

A large or (in our area) m.s. or small tree. Leaves with 1–2 prs. of pinnæ only, rhachis with a gland near the base, glabrous. Rhachis of pinnæ 2–5″ with 2–4 prs. of leaflets and a gland below all except the lowest pair. Leaflets elliptic-oblong acuminate dark green and shining, paler beneath, 2–5″ long by 1–1·5″ broad, penninerved and reticulate, young thinly pubescent. Heads small, peduncles slender, ·3–·7″ long, 1–4-nate in short axillary pubescent glabrescent panicles 2–3″ long. Flowers sessile, calyx with short lobes, corolla exserted to about twice the length of the calyx. Pod brown thin shining 5–9″ long by ·8–1·3″.

Bettiah and Ramnagar forests, near streams! Probably also in Purneah. Fl. April–May. Fr. March–April. Evergreen.
Bark light, nearly smooth. Blaze yellow and white.
The wood is said by the Tharus to be very strong and to be used for carts.

2. **A. procera,** *Benth.* Kare, *Th.*; Pandrai, *K.*; Safed Siris, *H.*; Garso, Kerso, *Kharw.*; Tentra, *Or.*

A large tall tree with characteristic greenish-white or white bark (except on very old trunks). Leaves with 3–6 prs. of pinnæ. Pinnæ

with a gland below the upper 1–3 prs. of leaflets or not. Lflts. 5–11 prs. broadly oblong or rhomboid-oblong 1–2·3″ by ·5–1·2″, much broader on the forward (acroscopic) side of the costa than on the basiscopic side, the costa being nearer to the lower edge except at the apex. Heads 1–4-nate copiously panicled, bracts caducous. Exserted part of corolla 1–1·5 times length of calyx. Pod 4–8″ by ·5–1″, thin strap-shaped, young often red.

In damp ground, along watercourses, etc., in all districts. Also occasionally planted but only attaining perfection in the forests near streams. Fl. Aug.–Sept. Fr. Dec.–May. In May and June it may be nearly or quite leafless for a very short time. There may be a second flush of new leaves in August growing through the panicle.

Attains 7–8 ft. girth. Blaze red. Youngest leaves silvery hairy, quickly glabrescent. Panicles nearly glabrous, large or only 3–4″. Calyx ·1–·12″ glabrous, teeth unequal. Corolla greenish-white, nearly ·25″ (measured from base of flower) and lobes about one-third as long. Fil. white, anthers yellowish, staminal-tube exceeding the corolla.

The timber is good. Carts are made from it in Champaran, it is used also for building, rice-pounders, etc. It is a good fuel. *Gamble* gives the weight at about 40–50 lbs. It grows very rapidly.

3. **A. lebbek,** *Benth.* Syn. Acacia Lebbek, *Willd.*; A. Sirissa, *Roxb.*; Siris, *H. Beng.*; Shirson, *Or.*; East Indian Walnut.

A large or m.s. tree usually noticeable when leafless from the numerous pendulous straw-coloured pods. Leaves with 2–4 rarely 5 pairs of pinnæ, rhachis with a gland below the uppermost pair of pinnæ and at the base. Pinnæ with a gland below the 2–5 upper prs. of leaflets. Lflts. 6–8 prs. rarely up to 13 prs., oblong ·75–2·25″ by ·35–1″ rarely twice as long as broad, rounded glabrescent, drying green, costa not less than one-third diam. of lflt. from and parallel to its upper edge. Peduncles stout 2–4″ long, 1–3 together in the axils of the leaves of the young shoots, rarely sub-panicled from the late development of these. Flowers with distinct pedicels which attain ·2″ long. Corolla exserted to twice length of calyx. Pods linear-oblong 6–12″ by 1–2″ broad.

Everywhere planted, very commonly along roadsides. Apparently wild in the Sameshwar Hills but rare! *Hamilton* speaks of a *Sirish* in Purneah allied to *Lebbek*, if not it. Apparently wild on the Damuda ghats, the Kuru ghats, in the hills above Ader (Ranchi), below Korgi and Adhe (Palamau), all in Chota Nagpur! Apparently wild along streams near Nakchi and Lohamunda (Athmallik)! Also in the Tikapara forest, near the Mahanadi and at Baghmunda, Angul! and in the Mals of Puri! Fl. April–June. Fr. ripens January and remains on the tree till the following March or April. Leafless during the hot season.

Bark rather rough and rugose, cinereous. Blaze deep crimson or red. Shoots, young leaves and inflorescence densely (often yellow-) tomentose. Stipules ·17″ linear deciduous, 2 minute stipellæ above the thickened petiolule of the pinnæ when young. Lflt. with 4-5-nerved base. Fls. scented, with a pedicel ·1–·12″ long. Calyx ·12″ pubescent. Corolla tubular-ventricose, often ·3″ measured from base of flower, slightly hairy above with lobes nearly ·12″.

Var. **rostrata,** *Haines.* Bark rough even on branches. Pod with a very long sharp beak. Wild below Korgi and Adhe, Palamau, near hill streams.

Var. **pubescens,** *Haines.* Tomentose, leaflets more or less permanently hairy and more narrowly oblong and up to 13 prs.

It is practically indistinguishable from the next species without flowers and fruit, and as the flower pedicels are also shorter than the type it is probably a hybrid.

Palamau near Daltonganj, probably of nursery origin.

The wood of *A. lebbek* is not much used in the province. *Gamble* says that it seasons,

works and polishes well and is fairly durable. The weight is given as about 50 lbs. It is very fast growing, but as an avenue tree its leafless condition and the dismal rattle of its pods in the hot weather make it very inferior.

4. **A. odoratissima,** *Benth.* Gobraha, *Th.*; Kiachalom, *K.*; Jang Siris, *S.*; Sirish, Tinia, *Or.*

A large or small tree, some forms graceful with drooping foliage. Leaves with 2–5 pairs of pinnæ, main rhachis with glands as in *lebbek* or glands abortive. Pinnæ with rhachis 3–10″ long, a gland between the upper 1–2 prs. of leaflets rarely absent. Lflts. 6–24 prs. (on same individual), oblong to narrowly oblong and sometimes subfalcate ·6–1·3″ by ·25–·5″, mostly under 1″ and twice to three times as long as broad, usually drying grey, finely appressed silky both sides, costa about one-fourth diam. of lflt. from the upper margin. Peduncles ·75–1·25″ long, 1–3 together in usually ample terminal panicles.* Flowers sessile. Corolla exserted to 4–5-times the length of the calyx. Pods purplish-green to brown or red when quite ripe 5·5–12″ long by about 1″ rarely 1·25″ broad.

In all districts! Chiefly in valleys. Fl. May–July. Fr. Nov.–Feb. Evergreen. The new leaves usually following the flowering, or with the flowers.

Bark grey or sand-coloured, blaze thick deep crimson. Shoots and panicle densely pubescent or tomentose. Leaf rhachis pubescent, lflts. pale beneath, silky or nearly glabrous except the margins and mid-rib, basal-nerves 5–6. Calyx campanulate, ·05–·06″, pubescent, scarcely toothed. Corolla hairy all over, funnel-shaped with tube exserted and lobes one-third to as long as tube, whitish. Filaments ·6–·7″ long.

The wood is used for much the same purposes as *A. lebbek* and is said to be durable. *Gamble* gives the weight as about 50 lbs. and says that it works and polishes well. It is sometimes lopped for fodder.

5. **A. Thomsoni,** *Brandis.* Sailari, Gondi.

A large and handsome tree with the young parts tawny or golden tomentose and old twigs dark grey densely appressed-hairy. Pinnæ 3–10 pairs 2–6″ long. Lflts. 5–10 on the first leaves, up to 25 prs. on later leaves, very unequal sided, base and lower side forming a right angle, ultimately glabrous both sides but rhachis villous, larger ·5–·75″ by ·25″. Peduncles appearing to be corymbose from the old branchlets but the young shoot bearing the inflorescence ultimately proliferous. Heads ·7–·9″ diam. (with st.) sub-corymbose on slender peduncles ·7–1·6″ greenish-yellow. Fls. ·17″ with slender pedicels ·1″ long. Pods red 6–8″ by ·6–1″ beaked, 6–8-seeded.

Angul; Tulka, Labangi, and Burkundi Forests! Fl. March while leafless. Fr. Nov.–Jan. The new leaves appear at the ends of the new shoots which bear the inflorescence during or just after flowering, rarely some peduncles also axillary in the new leaves.

Attains 6–7 ft. girth. Bark grey, smooth, slightly cracked below. Blaze dark crimson. Main rhachis with 1–2 glands between the uppermost pinnæ and a very large one on petiole. Lflts. pale beneath, sometimes slightly falcate, tip rounded and mucronate. Petiolule very short villose. Fls. fragrant. Calyx ·08″ pubescent, teeth very small obtuse. Petals greenish ·12″ pubescent, exserted and free to a distance as long as the calyx, narrow ell.-oblong subacute. Fil. ·4–·5″ long connate

* The panicle is always described as terminal and ample, but sometimes the bracts are replaced by young leaves and the inflorescence then assumes the form of that of *A. lebbek*. The two trees sometimes, I believe, hybridise (*cp.* var. *lebbekifolia* in C.P. list).

into a short tube at the base, white glabrous with greenish-yellow anthers. Ovary shortly stipitate, glabrous, or both it and young pod densely golden hirsute. (These last are diseased.)

Var. **galbana,** *Haines.*

It is remarkable that *Brandis* particularly states that the flowers are not scented and that the anthers are pink. He even says that these characters differentiate it from *A. odoratissima* and the *Flora of Madras* also quotes them. I have confirmed the observation in the Central Provinces, but our tree has *scented* flowers and *greenish-yellow* anthers! *Prain* in the *Calcutta Herbarium* writes—"*A. odoratissima* var. *mollis* = *A. Thomsoni*, which is not a good species." But the cover really contains a mixture of *A. odoratissima* with *A. Thomsoni* and this no doubt led to confusion. On no occasion on which I have seen *A. Thomsoni* in the forest have I for a moment confused it with *A. odoratissima* and it is an excellent species. The tree with scented flowers and yellow anthers I therefore consider as a variety of *Thomsoni*. The form, leaflets, time of flowering, character of inflorescence, pedicelled flowers and pod serve to distinguish it at every stage from *A. odoratissima*. The flowers are usually so high that I have always had to collect them by shooting down a branch; those of *odoratissima* can usually be reached from the ground.

6. **A. amara,** *Boivin.*

A small or m.s. tree with smooth greenish bark and the innovations softly yellow tomentose. Leaves with main rhachis 2–4″ long and 6–15 prs. of pinnæ 1–3″ long with numerous (15–25 prs.) close-set linear leaflets under ·25″ long with the costa nearly central. Fls. ·14–·15″ long (without st.) yellow, fragrant, in heads ·3–·5″ diam. (·3″ without the stamens), peduncles ·7–1″ long rather slender, closely yellow hairy, 1–4-nate in the axils of scales and of the new leaves or appearing shortly panicled owing to late appearance of these. Pedicels short. Corolla exserted to two to three times length of the calyx which is sub-entire, petals lanceolate about half as long as tube. Pod 4–6″ by ·7–1″ pubescent.

Fl. March-May.

The wood is strong.

Prain gives Orissa as a locality but I can find no specimens from our area either at Kew or Calcutta. The nearest locality where I have collected the tree was in *Raipur* in the Central Provinces!

7. **A. stipulata,** *Boiv.* Syn. A. marginata, *Merr.*; Kare, *Th.*; Kala Siris, *H.*; Japud, *K.*; Chapot, Kera-serom, *S.*; Ghora-lenja, *Or.*

A large handsome tree with feathery foliage. Pinnæ 12–20 prs. usually about 14 prs., 3–5″ long with hairy pubescent rhachis and about 30–40 prs. of semi-lanceolate leaflets ·15–·35″ long with the costa close to the forward margin, young pubescent, mature pubescent at base, margin and costa. Stipules large caducous. Fls. (with stamens) 1–1·25″ long on 1–5-nate peduncles often in the axils of stipuliform bracts in panicles 4–8″ long. Pods 3·5–6″ long by ·6–·8″ broad, dehiscent.

In the damper forests, usually near streams or ravines. Not common. Champaran to Purneah, frequent! Valleys in Singbhum! S.P., rare! Athmallik, near rivers! Angul!

Fl. May-June. Fr. Oct.-April. Evergreen or nearly so, new leaves Feb.-March. Attaining 8 ft. girth with a smooth pale grey bark with characteristic transverse furrows, but some forms when old have a rough bark below. Blaze crimson. Nearly all parts densely pubescent. Leaves about one foot long, sometimes likened to the Gul Mohur, whitish beneath. The large cordate stipules are very

conspicuous on the new shoots but so far from being persistent (as sometimes described) they are very caducous in our area. Fl. cream-coloured or white, sessile, the tubular-funnel-shaped calyx ·11″ long and the corolla twice as long or more, pubescent.

The wood is not used in the province but in some parts of India it is said to be used for building and for wheels. It was tried for tea-boxes in the Duars but there was no subsequent demand for it while I was in that district, though, under the name of "Sau," it was extensively planted both there and in Chota Nagpur among the tea, the growth of which it is supposed to improve. It is lopped for cattle fodder.

11. PITHECOLOBIUM, *Mart.*

Closely allied to *Albizzia* but sometimes spinescent. It differs chiefly in the compressed pod being circinate or spirally twisted, coriaceous or fleshy and dehiscent, and the seeds often arillate or embedded in pulp.

1. **P. dulce,** *Benth.* Syn. Inga dulcis, *Willd.*

A pretty tree with small stipular spines persistent on the trunk. Leaves with only one pair of pinnæ and these pinnæ with only one pair of small oblique leaflets 1–2″ long. Heads white ·5″ diam. in narrow panicles. Seeds 6–8 shiny black in a white pulpy aril.

It is often cultivated and deserves to be more so but I have not found it succeed on the Ranchi plateau and it is sensitive to frost. It is a native of Mexico. If repeatedly cut back it forms a good hedge and the pods serve as a cattle fodder.
Fl. Jan.–Feb. Fr. April–June.

12. ENTEROLOBIUM, *Mart.*

Differs from *Albizzia* in the somewhat thickened fleshy pod which is more or less septate within. It is indehiscent.

1. **E. saman,** *Prain.* Syn. Pithecolobium Saman, *Benth.*; The Rain Tree.

A large or m.s. tree with rather short trunk but large spreading crown, often forked from the base. Handsome when in flower from the numerous rose-coloured heads of flowers with long stamens against the dark-green leaflets.

Very commonly planted in stations in every district. Native of tropical America. Fl. May–June. Fr. March–April. Evergreen.

Bark dark grey. Shoots and rhachis pubescent. Leaf rhachis with often a gland between one to all the pairs of pinnæ, no gland at base. Pinnæ 3–7 prs., lowest with 2–3 prs. of leaflets only, larger with 8–10 prs. Lflts. usually 1–2″ long by ·5-1″, rhomboid with the costa diagonal, somewhat hairy beneath, esp. on the nerves. Peduncles 1-3-nate, 2-3″ long, axillary, or appearing racemed from arising in the axils of very young leaves. Fls. distinctly pedicelled with a bract on the pedicel. Calyx ·25″. Corolla-tube rather longer, lobes ·12″. Filaments very long pink. Pod 5–9″ fleshy with firm sutures.

A very easily grown tree of remarkably quick growth. The fuel is said to be useless (*Mackenzie, Fuel and Bamboo Plantations, Ind. For.*, 1917), but this may be due to the difficulty in splitting it. The tree is often much damaged by wind. The pods are sweet and are eaten by cattle.

The name is said to be derived from the multitudes of Cicadas which feed on the tree in the West Indies squirting out slender streams of fluid. The leaves give a good example of sleep movements. *Mr. Muries*, formerly of Darbhanga, found that this tree has the property of rendering *reh* soils fertile. I believe there has been no confirmation of this theory and possibly the efflorescence reappeared after the dense shade of the trees was removed.

FAM. 56. ROSACEÆ.

Herbs, shrubs or trees with stipulate alternate simple or variously compound leaves. Flowers regular, usually 2-sexual. Sepals imbricate in bud, sometimes an epicalyx present. Floral axis more or less hollowed out into a cupular or flask-shaped receptacle (hypanthium) lined above or entirely by the disc and bearing the sepals, petals and usually numerous, rarely definite, stamens. Carpels 1 to many, free or more or less adnate to the sides of the hypanthium, often entirely enclosed within it and when also connate forming with the latter a more or less syncarpous ovary. Ovules 1–2. Fruit very variable, sometimes of achenes free on the receptacle or nutlets sunk within it or sometimes forming with the fleshy swollen accrescent hypanthium a several-celled berry or pome.

I. Carpels free, not enclosed in the hypanthium.	
A. Carpel 1. Ovules 2, pendulous. Trees or shrubs.	
Calyx 5-lobed. Petals large	1. *Prunus.*
Calyx 5-toothed. Petals minute, sometimes sepaliform .	2. *Pygeum.*
B. Carpels many, exposed in fruit.	
1. Ovules 2 collateral, pendulous.	
Usually prickly shrubs	3. *Rubus.*
2. Ovule solitary, ascending. Herbs.	
Ripe carpels seated on the fleshy accrescent receptacle	4. *Fragaria.*
Ripe carpels seated on a dry receptacle	5. *Potentilla.*
II. Carpels many 1-ovuled free at the bottom of a flask-shaped hypanthium, styles free or connate above	6. *Rosa.*
III. Carpels definite 2-ovuled, enclosed in the hypanthium and adnate to its walls, more or less connate with one another to form a syncarpous ovary. Fruit a berry or pome.	
Flowers panicled	7. *Eriobotrya.*
Flowers fascicled or corymbose	8. *Pyrus.*

1. PRUNUS, *L.*

Trees or shrubs with simple entire or toothed, often gland-serrate, leaves with frequently 2 glands on the petiole. Fls. solitary fascicled corymbose or racemose. Sepal 5 deciduous in fruit. Petals conspicuous. Stamens perigynous. Carpel 1 with terminal style and 2 collateral pendulous ovules. Fruit a drupe, stone often 2-valved, 1-, rarely 2-seeded.

A. Leaves conduplicate in bud, lanceolate.	
Fls. peduncled appearing before the leaves	1. *amygdalus.*
Fls. sessile, appearing with new leaves	2. *persica.*
B. Leaves convolute in bud, ovate acuminate	3. *armeniaca.*

1. **P. amygdalus,** *Baill.*, is the Almond.

3. **P. armeniaca,** *Benth. & Hook. f.*, is the Apricot. Neither appear to thrive in our area.

2. **P. persica,** *Benth. & Hook. f.* The Peach.

A small tree with oblong-lanceolate or oblong-oblanceolate leaves 4–6″ long finely serrate or doubly-serrate, short petioles and with fimbriate stipules. Flowers sessile on the brachlets, pink. Fruit velvety.

Succeeds well on the Ranchi plateau.

The variety with a smooth shiny fruit is the *Nectarine*.

Plums and Cherries are species of *Prunus* and have no connection with the Jujube or Ber commonly called "*plums*" by Anglo-Indians.

2. PYGEUM, *Gaertn.*

Evergreen trees or shrubs with entire or toothed leaves, sometimes a pair of flat circular glands at the base of the blade. Stipules minute caducous. Flowers small racemose. Sepals minute 5–6. Petals 5–6, like the sepals or very small and villous. Stamens 10–40, often in series of 10. Carpel 1 with 2 collateral pendulous ovules, sometimes abortive. Fruit a transversely ellipsoid somewhat didymous drupe with scanty flesh, cotyledons hemispheric, fleshy, albumen 0.

Leaves entire. Stamens over 30 . . . . 1. *acuminatum*.
Leaves toothed. Stamens 10–15 . . . . 2. *lucidum*.

1. P. acuminatum, *Colebr.*

A small evergreen tree with coriaceous elliptic or oblong acute or shortly acuminate leaves 4–6″ by 1·5–3″, yellowish-green flowers in racemes 2–5″ long and transversely ellipsoid-oblong drupes ·75″ diam.

Along streams in the moist shady hill valleys of the Saranda forests! Very rare, but would probably also be found in the Mayurbhanj mountains. Fl. Aug. Fr. April–June.

Twigs brown with white lenticels. Leaves shining, some ovate, base rounded or shortly acute, mid-rib very prominent and sec. n. 6–8 strong beneath, arched, and looping some way from margin, cross tertiaries faint; glands present or not (on the same tree). Petiole ·5″ grooved above. Rhachis of raceme pubescent. Pedicels ·25″. Calyx ·12″ diam. pubescent. Fr. ·5″ on the shorter diameter, sometimes with a slight median vertical furrow, endocarp thin woody, testa papery veined.

2. P. Andersoni, *Hook f.* Syn. P. lucidum, *Anders.* (*Beng. Pl.*).*

A rigid shrub or small tree somewhat resembling a *Symplocos*, quite glabrous except the margins of the petals. Leaves coriaceous oblong or oblong-lanceolate obtusely acuminate, 1·5–3·5″ with rounded sub-acute or obtuse base and crenate-serrate margins, sec. n. 8–12, faint, nearly straight, bifurcate. Petiole ·3″. Racemes 1″ dense-fld. Pedicels very short. Hypanthium hemispheric, glabrous, sepals broadly ovate obtuse, petals twice as long, elliptic with densely ciliate margins. Stamens 10–15 with transversely oblong 2-celled anthers.

An interesting and very rare plant first collected by *Anderson* on Parasnath elev. 4300 ft. from a solitary tree on the northern side of the Central Peak. Since that collected several times, but only from the same locality and perhaps the same tree. The tree has also been found at Mahendragiri, Ganjam, elev. 4500 ft. by *Gamble* and *Fischer*.

Fl. and renews its leaves in November. Fruit not seen.

3. RUBUS, *L.* Raspberry.

Rambling prickly shrubs, rarely creeping herbs. Leaves simple or lobed or compound, stipules free or adnate to the petiole. Flowers

* The name *P. lucidum* was published without description in *Anderson's* paper on the Flora of Behar and the mountain Parasnath.

in terminal and axillary panicles, rarely solitary. Sepals persistent. Petals 5. Stamens many, inserted on the margin of the hypanthium or broad calyx-tube. Carpels many on a convex receptacle, style sub-terminal. Ovules 2 collateral, pendulous. Fruit of many 1-seeded drupels on the dry or spongy raised receptacle.

Leaves palmately 5-7-lobed . . . . 1. *moluccanus*.
Leaves pinnately 3-foliolate . . . . 2. *ellipticus*.

1. **R. moluccanus,** *L.* Syn. *vide* note.*

A shrub, easily recognisable as a Raspberry, with sarmentose prickly branches 3–5 ft. long, broadly ovate or sub-orbicular cordate lobed leaves with small prickles on the 5–7 strong primary nerves beneath and very dense axillary and terminal panicles of white rather inconspicuous flowers ·5″ diam. Fruit variable in size, scarlet fleshy.

Along the Pendra Valley, below Neterhat, elev. 3000 ft. Fl. Aug.–Oct. Fr. Sept.–Oct. Evergreen.

A very variable plant of which only the local form is here described. Branches tomentose. Leaves mostly 6 by 5·5″ with rounded dentate lobe hoary-tomentose between the nerves and hairy on the nerves. Panicles usually only 2–2·5″ long with laciniate stipules and bracts. Sepals acuminate reflexed in flower, erect ·5–·6″ long after flowering. Petals distant obovate ·2″ long.

The fruit is insipid.

2. **R. ellipticus,** *Smith.*

A large sarmentose shrub with branches 15 ft. long, long-hirsute with spreading red sub-setose hairs and with a silky-tomentose under-layer. Leaves pinnately 3-foliolate, petiole and rhachis hairy like the twigs. Lflts. usually elliptic 2–4″ long with an appressed hoary tomentum between the hairy nerves beneath and often small prickles along the mid-rib. Panicles small many-flowered with short pedicels and setaceous bracts. Flowers ·3–·5″ diam. with obovate petals exceeding the calyx. Fruit a yellow raspberry ·6″ diam., very sweet.

Sameshwar Hills, Champaran, elev. 2500 ft. ! Meghasani, Mayurbhanj, near rivers, elev. 3500 ft. ! Fl. Feb.–March. Fr. April–May. Evergreen.

The leaflets are usually rounded or obtuse at the apex, the Mayurbhanj form has them gradually acute, margin very sharply toothed, sec. n. 8–12 strong, often bifurcate near margin, tertiaries scalariform. Petiole 1–3″. Stipules setaceous. Sepals acuminate. Carpels silky.

The fruit is good eating.

4. FRAGARIA, *L.* Strawberry.

Perennial stoloniferous herbs with digitately 3–5-foliolate leaves and stipules adnate to the petiole. Flowers white or yellow, often polygamous. Calyx with an epicalyx of 5 bracteoles, sepals 5 valvate. Petals 5. Stamens many persistent. Carpels many on a convex receptacle, styles ventral, ovule 1 ascending. Fruit of numerous achenes separately sunk in the very swollen fleshy receptacle.

* This is apparently *R. rugosus, Sm.*, if the species is subdivided as is done in the *Flora of Madras*, but the bracts are rather variable though usually pectinate or laciniate chiefly at apex. It cannot be variety *Thwaitesii*, which is described as having black fruit!

1. **F. indica,** *Andr.* Yellow-flowered Strawberry.

A delicate procumbent herb with long rooting stolons. Leaves about 2″ diam. Leaflets obovate-cuneate with large lanceolate teeth which are sometimes again toothed, ·7–1·5″ long, thinly sericeous. Peduncles axillary, long and slender, only bearing 1 flower each which is yellow and about ·5″ diam. with calyx (including the epicalyx) exceeding the corolla. Fruit red.

Damp shady places, Purneah! Fl., Fr. Nov.–Jan.

Rootstock rather stout. Petioles very slender thinly villous. Stipules foliaceous toothed. Bracteoles of the epicalyx exceeding the sepals and sub-lobed or with 2–3 coarse teeth. Fruit sometimes very succulent but insipid, sometimes spongy.

2. **F. elatior,** *Ehrh.*

The cultivated strawberry, whose origin is probably *F. vesca, L.* (*Hooker f.*), succeeds fairly well on the Ranchi plateau. Fl. Feb.

5. POTENTILLA, *L.*

Perennial herbs, rarely shrubs, with compound leaves, stipules adnate to the petiole. Flowers usually yellow, sometimes white or red, sometimes unisexual or diœcious. Calyx 5- rarely 4-sepalous with an epicalyx of as many bracteoles, valvate. Petals as many. Stamens many, rarely definite. Carpels many, rarely definite, on a small receptacle which remains dry and does not become succulent in fruit, style ventral or terminal. Ovule 1 pendulous. Fruit of numerous achenes on the dry receptacle.

A. Flowers in sub-corymbose cymes.
  Diffuse. Radical leaves digitately 3–5-foliolate . . . 1. *Kleiniana.*
  Erect. Radical leaves pinnately 5–9-foliolate . . . 2. *Leschenaultiana.*
B. Flowers solitary axillary.
  Sub-erect or diffuse. Leaves pinnately 5–9-foliolate . . 3. *supina.*

1. **P. Kleiniana,** *W. & A.*

A diffuse or sub-erect annual or perennial herb with weak stems often 18″ long. Radical leaves long petioled digitately 3–5-foliolate, lflts. elliptic obovate ·7–2″ thinly hairy. Cauline leaves smaller and with shorter petioles upwards, 3–5-foliolate, obovate-cuneate, deeply-serrate. Fls. ·3″ diam., yellow in corymbs 2–6″ diam. Receptacle glabrous somewhat swollen or fleshy in fruit. Achenes 1 mm. long, oblique, keeled and with wavy ridges, glabrous or nearly so.

Highest hills of Ranchi and Palamau in grass near streams, Neterhat! Fl. April–June (perhaps all the r.s.).

Petioles laxly pilose, leaflets deeply sharply serrate except at the cuneiform base, with strong very oblique nerves, hairy. Leaves below the inflorescence sessile. Stipules ·3–·4″. Sep. oblong-lanceolate, bracteoles of epicalyx rather shorter than sepals sometimes bifid. Pet. obovate ·15″. St. about 20.

Distrib. Himalayas and Khasia hills and mountains of Burma, S. India and Ceylon.

2. **P. Leschenaultiana,** *Ser.* Var. biharensis, *Haines.*

An erect villous herb with woody rootstock, long-petioled pinnate radical leaves with 5–9 alt. orbicular broadly-elliptic or obovate leaflets ·7–1·8″ long with a subsidiary leaflet between or at the base

of several of the leaflets, cauline leaves pinnate, 3-foliolate or uppermost simple. Fls. yellow ·4–·5″ diam. in lax often corymbose cymes about 2″ diam. Achenes glabrous obliquely ovoid somewhat compressed with a dorsal rib and lineolate faces, on a conical sparsely villose receptacle.

Mountains of Chota Nagpur near streams. Neterhat 3000 ft.! Fl., Fr. May–July.

Radical leaves with petiole 6–8″ long, leaflets villous beneath strongly nerved, a nerve running into each of the large strong mucronulate teeth. Stipules large, foliaceous. Pedicels slender. Sep. ovate ·15″. Bracteoles lanceolate nearly as long. Pet. obovate slightly retuse.

Distrib. (of type) North-West Himalaya and Nilghiri Hills.

3. **P. supina,** *L.*

An annual herb 3–4″ and sub-erect, or with stems up to 1 foot very numerous and spreading from the root, hairy and leafy. Radical leaves (with petiole) 2–3″ flaccid, often absent when flowering, pinnate, with 5–7 rarely 9 obovate opp. and alt. lobulate leaflets ·2–·5″, lower cauline similar to the radical leaflets long-petioled, upper cauline with 3–5 leaflets short-petioled and lflts. usually small and obcuneate about 3-lobulate or incised-serrate. Fls. small yellow ·25″ diam., solitary axillary never corymbose, but often crowded on the repeatedly branched stems with much reduced leaves.

Northern tract, in damp places, Bettiah to Purneah (Malda, *C. B. Clarke*!). Fl., Fr. c s., also Feb.–April. Leaflets not always distinct.

6. ROSA, *L.* Rose.

Erect, sarmentose, or climbing usually prickly shrubs with pinnate leaves and serrate leaflets, stipules adnate to the petiole. Flowers terminal, solitary or corymbose. Hypanthium ovoid or pitcher-shaped with a contracted mouth bearing the foliaceous or sub-foliaceous sepals which are imbricate in bud. Petals normally 5, large. Stamens many inserted on the thickened disc at the throat of the hypanthium. Carpels many, rarely few at the base of the hypanthium, free, but their styles sometimes connate above, stigmas thickened, ovule 1 (rarely 2) pendulous. Fruit of dry coriaceous or bony indehiscent carpels (achenes) enclosed in the fleshy hypanthium which is often lined with hairs.

A concise and admirable summary of the roses usually cultivated in India is given in Brandis's *Forest Flora of North-West and Central India*. This is reproduced with some modifications in the *F.B.I.* The following appears to be the only rose indigenous in our area.

1. **R. involucrata,** *Roxb.* Jangli Gulab, *H.*; Koya, *Vern.* (Bihar, teste *Ham.*).

A pretty shrub, sometimes subscandent with arching branches. Pinnate leaves with 5–11, usually 7–9, small elliptic-lanceolate or elliptic-oblong lflts. ·25–1·25″ long, finely sharply serrate. Flowers 2″ diam. pure white solitary or in short corymbs.

Northern Tract, said to be common along the rivers. Purneah! In the Central and Southern tracts it is rare, but found along the larger rivers in the forest tracts. Singbhum! Daspalla! *Buch. Ham.* says that it was common in the "higher parts of the swamps of Purneah" (Puraniya, *vide* unpublished MS.). Fl. March–April.

Young parts and inflorescence tomentosely villous, gradually glabrescent.

Leaves 2-4″ long only, lflts. shining, stipules with very narrow segments. Styles distinct, ending in a discoid mass of stigmas. Fruit globose, tomentose (not seen by me), the sepals deciduous.

7. ERIOBOTRYA, *Lindl.*

Trees with simple coriaceous leaves and white flowers in dense panicles. Sepals small persistent on the turbinate or clavate hypanthium. Petals 5 contorted or imbricate, obovate or orbicular. Ovary 2-5-celled with styles connate and woolly below. Ovules two in each cell, basal, ascending. Fruit baccate with very thin endocarp and large angled seeds with very thick cotyledons.

1. **E. japonica,** *Lindl.* Loquat, Japanese Medlar.

A small tree with stout branchlets, leaves beneath and inflorescence densely woolly. Leaves large, 6–12″ long, sub-sessile, lanceolate or oblanceolate acuminate, dentate or serrate with 15–20 strong sec. n. Flowers ·5″ diam. in dense stout panicles 3–6″ long. Fruit ovoid yellow succulent 1–1·5″ long, 1–5-seeded.

A native of Japan, frequently cultivated and succeeding well on the Ranchi plateau and in the Northern Area. Fl. Sept.-Oct. Fr. March-April.
An excellent fruit.

Pyrus communis, *L.* The common Pear is cultivated on the Ranchi plateau but yields a fruit only fit for cooking.

FAM. 57. SAXIFRAGACEÆ.

Trees, shrubs or herbs with alt. or opp. nearly always simple leaves stipules sometimes adnate, always exstipulate when opposite. Flowers regular. Sepals imbricate or valvate usually on a distinct hypanthium which varies much as in the Rosaceæ, from which family the alternate leaved genera are separated chiefly by habit, by the definite stamens equal to or double the number of the petals, ovary of 2–5, commonly 2, free or connate carpels but usually united below and often forming a 1-celled ovary below, and by the numerous ovules and seeds. Placentation in 1-celled ovaries is parietal or the placentæ are pendulous, in 2-more-celled ovaries axile. The opposite-leaved genera often have numerous stamens.

Our only representative (indigenous) genus is not at all typical. To the family also belongs the *Hydrangea*, which is often cultivated.

1. VAHLIA, *Thunb.*

Herbs with opposite entire exstipulate leaves, but sometimes with a stipular line. Flowers axillary, usually paired. Sepals 5 superior persistent. Petals 5 and st. 5, epigynous. Ovary inferior 1-celled with 2 pendulous placentæ and many ovules, styles 2. Capsule dehiscing apically between the styles. Seeds numerous, minute, ellipsoid, smooth.

Peduncles ·3–·7″, 2-fld. Filaments without basal scale . . 1. *oldenlandioides.*
Flowers sub-sessile. Filaments with a minute basal scale . . 2. *viscosa.*

1. **V. oldenlandioides,** *Roxb.*

A small plant very like an *Oldenlandia*, usually erect or diffuse, much branched about 6″ high, shortly sparsely pubescent all over and also

glandular above. Leaves ·5–2″, subsessile, linear to linear ovate. Peduncles 2-fld. in all the axils, ·3–·7″ long. Fls. white (or yellow?) with 5 small erect triangular sepals, petals about ·17″ long, obovate. Capsule sub-globose ·12″ diam.

In fields. Behar, *Kurz*! Puri! Fl., Fr. c.s.

2. V. viscosa, *Roxb.*

Densely branched from the root with stems up to 10″ and even more densely flowered than the last, glandular-pubescent. Leaves ·5–1″ long sub-sessile, ovate to lanceolate, narrowed both ends. The flowers are *sub-sessile* (peduncles up to ·1″) and the filaments have a minute hairy scale at the base which is absent in the last.

Dry rice-fields. Fl. Feb. On grounds of distribution probably occurring in our area.

There are frequently axillary branches congested in the leaf axils which makes the resemblance of this genus to the *Rubiaceæ* the more striking.

FAM. 58. CRASSULACEÆ.

Herbs, rarely undershrubs, usually with simple (exc. *Bryophyllum* and *Kalanchoe*) alternate or opposite fleshy exstipulate leaves and regular racemose, cymose or panicled flowers. Sepals and petals usually 4–5, free or gamophyllous. Stamens hypogynous or epipetalous, as many as or twice the petals. Carpels as many as petals, rarely only 3, free or connate below, narrowed upwards into distinct styles. Hypogynous glands or scales sometimes present at the base of each. Ovules on the edges of the carpels, usually many. Fruit follicular; seeds albuminous with terete embryo and short cotyledons.

Calyx with long inflated tube and 4 short lobes . . . . . 1. *Bryophyllum.*
Calyx 4-partite . . . . 2. *Kalanchoe.*

1. BRYOPHYLLUM, *Salis.*

Erect perennial herbs with opposite simple or 3-partite crenate leaves. Flowers large drooping, in panicles with opposite spreading branches. Calyx large inflated, shortly 4-lobed. Corolla gamopetalous with short 4-fid limb. Stamens 8, 2-seriate, inserted on middle of the corolla tube. Hypogynous scales 4. Carpels 4, free or connate at base, ovules very many. Follicles 4, many-seeded.

1. B. calycinum, *Salis.* Kop-pata, *Beng.*; Life-plant.

A glabrous fleshy herb with simple or 3-foliolate (at base) leaves, oblong or elliptic crenate or very coarsely crenate leaflets 2–6″ long and flowering stems 1–3 ft. high bearing a panicle of pale greenish and purple flowers with inflated campanulate calyx ·8–1·5″ long with 4 deltoid lobes. Corolla nearly included, sub-globose at base and constricted in middle, tip reddish purple. Follicles included in the persistent perianth.

Frequent in Orissa in rocky waste ground on the edges of streams! Very commonly cultivated and sometimes spreading as an escape. Fl. Dec.–Feb.

The plant is remarkable by the facility with which it produces buds and young plants from the leaf-crenatures when these are laid on damp ground. Young plants will even form in the botanical drying press and sometimes grow an inch in length before dying.

2. KALANCHOE, *Adans.*

Erect stout usually fleshy perennial herbs with opposite leaves, or the upper alternate, lower or all sometimes pinnate or pinnatifid or 3-foliolate. Flowers large usually yellow with calyx deeply divided and corolla with a spreading limb above the gamopetalous flask-shaped tube, much exceeding the calyx. Stamens 8, 2-seriate, adnate to corolla-tube. Scales 4. Carpels 4, rarely 5, adnate to base of corolla. Ovules many. Follicles 4.

Leaves simple obovate-elliptic, crenate . . . . 1. *heterophylla.*
Leaves, or some of them, deeply pinnatifid . . . . . . 2. *laciniata.*

1. **K. heterophylla,** *Prain.* Syn. K. floribunda, var. glabra, *F.B.I.*; Cotyledon heterophylla, *Roxb.*

About 1–3 ft. high when in flower, with opposite fleshy ovate-oblong, or upper elliptic, leaves 2–3″ long which are crenate or (fide *Roxburgh*) slightly laciniate. Fls. clear yellow (white or pale-pink, *C. B. Clarke*) in compound corymbose glabrous cymes with numerous small lanceolate bracts ·12″ long. Sepals oblong acute. Corolla-tube ·3–·4″ long, lobes ·2–·25″ lanceolate.

Parasnath, elev. 4000 ft., *J.D.H.* ! Fl. April.
The young plants have sometimes ternate leaves. Petiole short.

2. **K. laciniata,** *DC.*

Sometimes almost woody below 1–3 ft. high when in flower with the lower and sometimes all the leaves pinnatifid with very narrow usually entire lobes or (at least in cultivation) 2–3-pinnatifid. Fls. bright yellow 1″ diam. in panicled cymes, sepals lanceolate, glabrous or pubescent.

Patna, *C. B. Clarke.* But it is so commonly cultivated and so easily spreads that I think this was probably not indigenous.

FAM. 59. DROSERACEÆ.

Small herbs usually with whorled radical leaves and cauline leaves alternate or 0, copiously covered with long glandular hairs secreting fluids by means of which they catch and digest minute insects, sometimes diaphanous and glabrous and then with automatically closing laminæ. Flowers small regular axillary or on slender scapes. Calyx 4–8-partite or sepals free. Petals and stamens as many as the sepals, hypogynous or very slightly perigynous. Ovary nearly free 1–3-celled with 5–3 styles. Ovules many on parietal placentæ equal in number to the styles. Capsule membranous 5–3-valved, many-seeded. Seeds many with fleshy albumen, embryo cylindric or minute.

Leaves glandular, cauline 0 or alternate . . . . . . 1. *Drosera.*
Cauline leaves whorled vesicular glabrous . . . . . 2. *Aldrovanda.*
(*Aldrovanda* has been found in salt pans south of Calcutta close to but not within our area. It is not further dealt with.)

1. DROSERA, *L.* Sundew.

Small green or red herbs usually found in wet places with small rosettes of radical leaves or with erect or decumbent leafy stems with alternate leaves which are usually circinate in vernation. Stipules

0 or adnate to petiole. Sepals persistent. Petals white or rose, marcescent. Stamens hypogynous or slightly perigynous. Ovary 1-celled with 2–5 styles. Fruit loculicidally 2–5-valved. Seeds many obovoid ellipsoid.

Leaves forming a close rosette, stem 0 . . . . 1. *Burmanni.*
Stem elongate with linear leaves . . . . 2. *indica.*
Stem with lunate peltate leaves . . . . 3. *peltata.*

1. **D. Burmanni,** *Vahl.* Mukha-jali, *H.*

A pretty little plant with a very close compact rosette of obovate or obcuneate leaves ·25–·4″ covered with (usually scarlet) gland-hairs. Scape erect 3–8″ high, sometimes forked. Flowers rose-pink or white secund in a helecoid cyme, usually only one or few opening at a time. Pedicels erect in fruit. Calyx reddish covered with short papillæ.

Locally abundant, especially in Purneah! Also found in Chota Nagpur! Generally on damp sandy ground where water has stood during the monsoon but sometimes (in Purneah) on rather high ground. Fl. Nov.–April.

The stipules in *F.B.I.* are said to equal half the petiole. Those in my specimens are as long as or exceeding the petiole, shortly adnate and intrapetiolar with long fimbriæ.

2. **D. indica,** *L.* Linear-leaved Sundew.

A slender little plant with sub-erect or decumbent weak stems a few inches long with linear leaves 1–2″ long covered with long gland-tipped hairs. Flowers larger than in the last ·5″ diam. with long pedicels ·3″ long in helicoid cymes 2–4″ which are usually lateral on the stem (not radical but probably terminal, the branching being cymose). Pedicels spreading in fruit. Sepals lanceolate ·15–·2″ thinly gland-hairy.

Frequent in wet ground near tanks and river-beds. Chota Nagpur, common! Puri! Probably in all districts, ascending to top of Parasnath. Fl. Sept.–Jan.

3. **D. peltata,** *Sm.*, is said to occur throughout India, but I have seen no specimens from our area. It is a hill plant and might be found at Neterhat.

FAM. 60. HALORRHAGIDACEÆ.

Small terrestrial herbs (excluding South American genera) or aquatics with opposite or whorled, or upper alternate, simple or (in aquatic species) pectinately-pinnatisect exstipulate leaves. Flowers reduced, solitary or clustered axillary or by reduction of the leaves running out into spikes, 1–2-sexual. Calyx lobes 4 or 0. Sepals and petals 4 or 0 superior. Stamens 8, 4 or reduced to 1, epigynous. Ovary 4-, 2- or 1-celled with a like number of simple or fimbriate styles. Ovules 4 altogether, pendulous. Fruit small dry or drupaceous, indehiscent or separating into its carpels.

Stamens 4. Leaves submersed whorled often pinnatisect . 1. *Myriophyllum.*
Stamen 1. Submersed leaves entire opposite, floating pseudo-whorled . . . . 2. *Callitriche.*

[*Callitriche* is shown here in the place allotted to it in the genera *Plantarum.* It has, however, already been dealt with next to the *Euphorbiaceæ.* It has 1-sexual flowers, and whether the ovary is superior or inferior it is not possible to say.]

1. MYRIOPHYLLUM, *L.*

Slender aquatic herbs with the submerged leaves whorled or rarely upper alternate, submerged ones usually finely cut into capillary segments, exserted ones toothed, rarely all simple and toothed or entire. Fls. inconspicuous axillary or in spikes appearing above the water, 1–2-sexual. Sepals 4, rarely 2 or 0 on a short tube in the male, hypanthium longer and 4-furrowed in herm. fl. or fem. fl. Petals 2–4 concave, sessile. St. 2, 4 or 8 in male, sometimes 0 in female. Ovary inferior 4- rarely 2-celled. Fruit 4-furrowed sometimes separating into 4 or 2 cocci. Seeds albuminous with central terete embryo.

Flowers white or pink with much fimbriate stigmas, carpels with acute dorsal ridges . . . . 1. *tuberculatum.*
Flowers white, stigmas slightly fimbriate, carpels rounded on back . . . . 2. *indicum.*

1. **M. tuberculatum,** *Roxb.*

A submerged aquatic with lower leaves 1–1·5″ long cut into filiform segments and somewhat leafy spikes of minute flowers 3–5″ long, often lateral as well as terminal, floral leaves simple linear-oblanceolate toothed ·25–·5″ long. Upper fls. male, lower female, but sometimes hermaphrodite fls. also present. Petals white, stamens 4 with yellow anthers. Stigmas pink very fimbriate. The plant in fruit is easily recognised from the 4 radiating sharply angled tuberculate carpels, the whole fruit about ·1″ long and broad.

Probably generally distributed. Fl., Fr. Sept.–Dec.

2. **M. indicum,** *Willd.*

Habit of preceding except that the plant is much more flaccid and leaf segments more capillary so that the plant collapses into a tassel when taken from the water. Floral leaves usually very short ·1–·2″ long, rarely ·3″ long narrow lanceolate toothed. Spikes dense at the top. Fls. ·04″ long. Fruits ·08″ diam. 4-lobed, the lobes with rounded angles, not or scarcely tubercled.

Bengal, *J.D.H.*! Herb. Ham. (without locality, possibly Purneah)! There are no good specimens from our area though it almost certainly occurs, especially in Orissa.

Fl., Fr. July–Sept.

FAM. 61. RHIZOPHORACEÆ.

Trees or shrubs, often littoral and furnished with pneumatophores (sometimes called blind root-suckers) and aërial roots, generally glabrous with opposite entire simple coriaceous leaves and interpetiolar deciduous stipules which enclose the terminal bud and leave prominent scars. Flowers regular, 2-sexual, often coriaceous, on 1-many fld. axillary peduncles. Calyx superior or half-superior on a cupular or campanulate hypanthium, 4–14-lobed or -sepalous. Petals as many, often 2-fid and laciniate. Stamens twice as many, rarely indefinite, perigynous or epigynous. Disc usually lining the hypanthium above the ovary which is inferior or free, 2–5- rarely

1-celled. Ovules 2 pendulous in each cell or pendulous from a central placenta in 1-celled ovaries, style 1. Fruit usually a coriaceous 1-seeded berry (tardily dehiscent in *Weihea*). Seed usually albuminous but albumen quickly absorbed by the growing embryo, rarely arillate. Embryo usually without a period of rest but germinating on the tree, in other cases minute. Cotyledons either fused or distinct, sometimes 3–4.

The Mangroves are usually distinctly xerophytic, the salt water being a physiologically dry environment, and the leaves often bear water-tissue below the epidermis. The pneumatophores as well as the stilt-roots and aërial roots have numerous large lenticels and air-conducting tissue to supply oxygen to the submerged parts.

In aërial germination the cotyledons at first enlarge in some cases but this growth is quickly superseded by that of the hypocotyledonary axis or tigellus which may attain 1–3 ft. in length while still on the tree. On falling it plunges deep into the soft mud either bearing with it the cotyledons (*Bruguiera*) or separating circumscissilely from the fused cotyledonary body.

Dots in the leaves are due to cystoliths of Calcium Oxalate.

- I. Flower epigynous, the ovary completely adnate to the hypanthium (before pollination). Fruit indehiscent.
  - A. Hypanthium flask-shaped, not or scarcely produced into a limb above the ovary. Calyx girting the fruit, 4–6-sepalous.
    - 1. Sepals 4. Petals entire. Anthers many-locellate . . . 1. *Rhizophora.*
    - 2. Sepals 5–6. Petals lobed or cut. Anthers 4-celled.
      - Stamens 10–12. Ovary 3–4-celled . . . . . 2. *Ceriops.*
      - Stamens indefinite. Ovary 1-celled . . . . . 3. *Kandelia.*
  - B. Hypanthium spherical or tubular produced above the ovary. Calyx above the fruit, 5–14-sepalous.
    - Sepals 8–14. Petals embracing the stamens . . . . 4. *Bruguiera.*
    - Sepals 5–8. Petals not embracing the stamens . . . 5. *Carallia.*
- II. Flower perigynous, the ovary free in the hypanthium . . 6. *Weihea.*

1. RHIZOPHORA, *L.* Mangrove.

Evergreen trees or large shrubs with little main trunk and numerous stout usually arched adventitious roots. Leaves coriaceous mucronate or apiculate. Fls. rather large, coriaceous, on axillary few flowered bracteate cymes. Sepals 4. Petals 4 entire. Stamens subsessile with many-celled anthers inserted on the fleshy margin of the hypanthium. Ovary 2-celled produced beyond the adnate hypanthium as a cone, stigma 2-fid. Ovules 2 in each cell. Fruit ovoid girt with the persistent sepals. Albumen present before germination. Cotyledons fused and acting as a continual absorber of nutriment for the largely elongating hypocotyl which ultimately grows far beyond the fruit and is club-shaped. The upper end with the small plumule finally detaches itself circumscissily from the cotyledonary mass and drops into the mud.

True specialised pneumatophores are generally absent, their function being assumed by the upper part of the stilt-roots which is copiously supplied with lenticels and air tissue.

- Cymes long-peduncled 3–5 flowered . . . . 1. *mucronata.*
- Cymes very shortly peduncled with 2 subsessile flowers . . 2. *candelaria.*

1. R. mucronata, *Lamk.* Rai, *Or.*; The Common Mangrove.

A handsome small tree standing on stilt roots, with elliptic or broadly elliptic coriaceous leaves 4–6″ long cuneate both ends and

tipped with a short blunt awn, brown or black dotted beneath and also microscopically pale-punctulate. Flowers in long-peduncled few-fld. cymes, very coriaceous, ·4–·7″ long. Fruit brown at time of germination 1·5–2″, obpyriform.

Orissa, tidal swamps of the Mahanadi delta! Fl. Dec. also April-June. Evergreen.

Bark smooth. Blaze pink. Branchlets closely marked with leaf and stipular scars, leaf buds subterete slender 1·5–2·5″. Petioles ·6–1·5″. Peduncles on the young branches, usually only 3-flowered, 1–1·5″ long. Fls. yellowish, pedicelled, cyme branches and pedicels each with two terminal bracteoles united by their bases. Calyx split ⅘ths to the base of the flower, sepals broad-lanceolate. Petals fleshy woolly on the inner face. Anthers leathery apiculate with an oblong-lanceolate basi-fixed ligule covering the locellæ.

Fruit with the reflexed sepals ·4–·5″ long, the germinating tigellus and radicle reaching one foot or more before dropping.

One year old seedlings (communicated by *Mr. C. G. Rogers*) are 3–4 ft. long with the lower part ·6″ diam. warted with large lenticels and 3–4 pairs of narrow elliptic leaflets. I have a note of numerous slender erect pneumatophores in this species.

The bark is largely used for tanning.

2. **R. candelaria,** *DC.* Syn. R. conjugata, *F.B.I.* (not of *Linn.*); Rai, *Or.*

A tree very similar in general appearance to the last but distinguished in the forest by its narrower leaves which are often subacuminate. Peduncles very short and stout bearing two sub-sessile flowers only. Fruit narrower, the 4 reflexed sepals oblong ·4–·5″ long.

Orissa, tidal forests of the Mahanadi delta! *Mr. Rogers* points out that in Burmah and elsewhere this tree is usually found in less deep water than *R. conjugata* in association with the *Bruguieras* and has therefore less stilted roots. Fl., Fr. April-June and perhaps at other times.

Petiole ·5–1″, often rather shorter and stouter and the sec. n. more distinct than in *R. mucronata*. Peduncles mostly from the axils of fallen leaves ·2–·35″ long, bracteoles forming a cup receiving the base of the ·5″ long flower. Petals thin, glabrous.

Bark used for tanning as in the case of *R. mucronata*. The one-year seedling has elliptic-lanceolate leaves and the lower part is far less warted or nearly smooth as compared with *R. mucronata*.

(The unfortunate change of name appears necessary, vide *Kew Bulletin*, 1920, p. 51.)

2. CERIOPS, *Arn.*

Small trees or shrubs with ovate or obovate leaves and small flowers in axillary peduncled heads with bracts and bracteoles at their base. Sepals 5–6, petals 5–6. Stamens in two whorls, diplostemonous, filaments inserted between the lobes of a crenate disc. Ovary with free top only, growing up in fruit far beyond the calyx-tube which girts its base, 3-celled, cells 2-ovuled. Fruit 1-celled and 1-seeded. Germination as in *Rhizophora*.

1. **C. Roxburghiana,** *Arn.* Goran, *Beng.*; Gartah, *Or.*

A tall shrub or a small tree with many upright branches, coriaceous obovate rounded leaves mostly 2–3″ and small greenish-white sessile flowers in short-peduncled heads. Flowers each with a brown-edged bract and 2 bracteoles at base. Sepals 4–6. Petals 4–6 shorter oblong puberulous or pubescent with white fimbriate margins.

Stamens 8–10 (10–12, *F.B.I.*) inserted outside the crenate disc. Fruit ·5–·6″ girt by the calyx about one-third from base.

Orissa, tidal forests of the Mahanadi delta! Fl., Fr. April-May.

With numerous pneumatophores. Blaze white, turning brown. Leaf buds compressed linear 1″. Leaves sometimes up to 4″ by 2″, base cuneate on the ·4–1″ long petiole. Peduncles ·1–·3″. Sepals ·2″ thick fleshy lanceolate acute 3-angular. Petals conduplicate embracing the inner whorl of stamens. Ovary at first with free top only, ultimately growing up conically far beyond the calyx tube as in *Kandelia*. Germinating embryo 4–5″ before dropping, often curved, seedling leaves narrowly obovate.

3. KANDELIA, *W. & A.*

A small tree with oblong coriaceous leaves and moderate-sized white flowers in long-peduncled cymes. Fls. sheathed at base by connate bracts. Hypanthium turbinate produced above the ovary and with an annular disc within. Sepals 5–6 linear. Petals 2-fid with multifid lobes. Stamens numerous. Ovary 1-celled, conical tip growing out in fruit beyond the calyx. Ovules usually 5 abortive and 1 fertile on a central column. Fruit 1-celled and -seeded.

The germination is said to be as in *Rhizophora* but I have not examined it. The germinating seedling may attain 1 foot in length before falling. The first stem is bifurcate (always ?).

1. **K. Rheedii,** *W. & A.* Rasunia, *Or.*; Goria, *Beng.*

A small spreading tree with thick twigs, leaves 4–5″ long rounded at the apex and white flowers with white linear sepals ·5–·6″ long. Petals caducous. Fruit 1″ long, a double cone girt by the calyx at their common base.

Orissa, tidal forests of the Mahanadi delta, usually fringing the creeks and leaning over the water! Fl., Fr. all the year round. Evergreen.

Leaf buds flat linear with stipules 1″. Leaves tapering into the ·3–·7″ long petiole, microscopically dotted beneath, sec. n. not visible. Peduncles 1–1·7″ long, usually once bifurcate and each branch with 2 pedicelled flowers, sometimes twice branched. Hypanthium turbinate-campanulate, sepals finally reflexed.

4. BRUGUIERA, *Lam.*

Large or small trees with coriaceous leaves and rather large coriaceous flowers on 1–many-fld. peduncles. Sepals and petals 8–14 on the obconic, campanulate or ellipsoid hypanthium. Petals oblong 2-lobed with a bristle in the sinus, lobes sometimes fimbriate. Stamens twice the petals, embraced by them and springing elastically forward when ripe, filaments slender, anthers linear, mucronate. Ovary 2–4-celled inferior. Style slender, stigma minute, 2–4-lobed. Fruit girt by the calyx, 1-seeded.

The germination is said to be as in *Rhizophora* but it is only superficially so. There are 3–4 cotyledons, sub-connate while in the seed with absorbing tips in the gelatinous albumen. On protrusion of the radicle the style and its base is thrown aside as a cap, and when ripe for falling the whole embryo including the linear-oblong cotyledons falls. The latter *not* remaining behind and circumscissilely breaking off as in *Rhizophora*.

The *Bruguieras* are found in shallower water than the *Rhizophores* and often develop a large trunk.

Leaves elliptic, petioles over 1″. Flowers solitary . . . . 1. *gymnorhiza*.
L. narrowly-elliptic, petiole under 1″. Fls. 2–3 . . . . 2. *caryophylloides*.

1. **B. conjugata,** *Merr.*, inc. B. eriopetala, *W. & A.* Syn. B. gymnorhiza, *Lamk.*; Rhizophora conjugata, *L.*, non *F.B.I.*; Kekra, Rasinia, *Or.*

A small straight tree with elliptic, or sometimes somewhat elliptic-obovate, shortly acuminate leaves 3·5–5″ with petioles 1–2·5″ long, large solitary campanulate flowers 1–1·3″ soon reflexed with the tube rather shorter than the 10–12 linear-subulate sepals. Petals 2-lobed ·55″ with a long bristle from the sinus and 0–3 shorter ones near the end of each lobe.

Orissa, tidal forests of the Mahanadi delta! Fl. April-June and perhaps at other times. Evergreen.

Bark grey, nearly smooth; blaze bright crimson. Stipules about 2–2·5″ long, buds subterete. Brown dots on the leaf absent or very few. Sepals rarely 14, tube usually ridged.

I have united *B. eriopetala* with this species. *Mr. Rogers* agrees with me that it at most is no more than a variety.

α. **conjugata** proper. Petals villous on the margins at the base nearly glabrous above with 2–4 bristles on each lobe.

β. **eriopetala,** *W. & A.* sp. (*Wight Ill.*, i, p. 210). Petals densely villous along the whole margin with 0–1 bristle on each lobe. Intermediates may, however, occur with petals sparingly fringed throughout and more than 1 bristle on a lobe. Occurs in same localities as the type.

The tigellus and radicle are much shorter than in the *Rhizophoreæ*, being only about 6″ long when the leafy shoot emerges. *Mr. Rogers* states that it is found in somewhat shallower water (in Burma).

2. **B. caryophylloides,** *Blume.* Kekra, Karika, *Or.*

A small erect tree with narrowly elliptic or lanceolate-obovate leaves 3–4·5″ cuneate or shortly acuminate at apex and narrowed at base into a petiole ·75–1″ long. Flowers whitish 2–3 pedicelled on a short axillary peduncle, with ellipsoid-obconic tube ·15–·2″ long and erect or spreading sepals ·15″ long which soon become reflexed and enlarged to ·3″ and the tube to ·4″. Young embryo very early penetrating the top of the fruit which is at first below the top of the calyx-tube.

Orissa, tidal forests of the Mahanadi delta! Fl. April-June. Evergreen.

Leaf buds compressed at base, very acuminate, leaves microscopically dotted beneath, sec. n. not visible (when fresh), stipules 1·5″. Peduncles ·3″ with two rather membranous deciduous bracts at the top ·15″ long. Pedicels shorter than peduncle. Sepals and white petals 8, petals shorter than calyx, apex fimbriate. St. about 16. Fruiting calyx ·4″ somewhat urceolate crowned by the spreading or reflexed sepals.

Young embryo slender, not more than 4–5″ long while on the tree.

5. CARALLIA, *Roxb.*

Trees or shrubs with entire or serrulate leaves and small greenish or white flowers sessile in short dense 3-chotomous cymes. Hypanthium minutely bracteate at the base and produced above the ovary with 5–8 sepals and a crenulate disc. Petals and stamens inserted on the margin of disc; petals clawed, orbicular or quadrate, small, 2-fid or entire. Filaments slender. Ovary 3–4-celled, style with 3–4-lobed stigma. Fruit small globose coriaceous, crowned by the calyx.

Leaves entire. Petals white . . . . 1. *integerrima.*
Leaves serrulate. Petals yellow . . . . 2. *lucida.*

1. **C. integerrima,** *DC.* Jur, *K.*; Kierpa, *Beng.*; Manj, *Or.*

A small tree with shining leathery oblong, elliptic or obovate shortly suddenly obtuse or obtusely acuminate leaves 3–6·5″ long and stout dense 2–3-chotomous cymes 1–2″ long of small greenish flowers with inconspicuous white erose petals. Fruit ·25″ diam.

Purneah! Singbhum, frequent along the banks of streams and dry nalas! Santal Par.! Athmallik! Angul! Sambalpur, along streams! Fl. Dec.–April. Fr. r.s.

Attains 5 ft. girth but no great height. Bark smooth grey, blaze hard red. Aërial roots sometimes present. Twigs somewhat 4-angled. L. sometimes 8″ by 3″, base often cuneate or attenuate, crystal-cells visible as dots, sec. n. close oblique, anastomosing within margin. Peti. ·3–·5″. L.-buds linear-lanc. ·5–·75″ acuminate, enclosed by the caducous stipules. Peduncle ·5–·75″. Fls. obconic ·17″. Pet. 6–8, 2-fid. and lacerate

Wood hard and red, said to be good and useful for furniture, cabinets and veneering. *Gamble* gives weight as 46 lbs.

2. **C. lucida,** *Roxb.*

A specimen collected by me in Purneah with serrulate leaves exactly matching *C. lanceæfolia, Roxb.*, may be this. It is young with acuminate leaves, without flowers. Possibly a seedling of *C. integerrima*? Have these serrulate leaves?

6. WEIHEA, *Spreng.*

Trees or shrubs with oblong entire or obtusely serrate leaves. Flowers on 1–more-fld. peduncles with connate bracts enclosing the buds. Calyx 4–5-fid. patent, on a campanulate hypanthium with a low slightly lobed disc, under the margins of which the clawed spathulate fimbriate-lacerate petals are inserted. Stamens 16–30 inserted on the margin of the perigynous disc with slender filaments and oblong anthers. Ovary 2–4-celled with filiform style, stigma with 2–4 lobes. Ovules 2 in each cell. Fruit globose fleshy but tardily septicidally dehiscing into 2–4 valves, 2–4-celled each with 1–2 seeds. Seeds arillate, ovoid, subtrigonal with straight embryo and elliptic cotyledons.

1. **W. ceylanica,** *Baill.*

An erect much-branched shrub 3–4 ft. with lenticellate brown twigs and very coriaceous opaque oblong or ovate-lanceolate leaves 2·5–3·5″ long shining above with obtuse tip and rounded or sub-obtuse base. Sec. n. 5–7 very slender. Petiole ·2″ pubescent. Stipules interpetiolar oblong obtuse erect or recurved ·15″ long, pubescent. Fls. solitary or geminate axillary shortly pedicelled, globose buds enclosed in 2 orbicular bracts which are nearly glabrous except at base and ciliate margins. Sepals 5 thick valvate densely silky ovate acute, shortly bearded within near the apex. Pet. 5 broadly ovate or quadrate pectinate nearly to the middle. St. 30 with very short filaments (in bud) and oblong 2-celled anthers with cells on the inner face. Ovary conical villose, style with 3 short stigmas.

Rocky margins of the Chilka Lake! Flower buds Dec.–Jan.

My specimens from which above description is taken are in very young bud; it is therefore not possible to give the measurements of the parts of the flower. The following details are from specimens outside the province; ours may possibly be a new species; it is 5-merous.

L. often acuminate, petiole up to ·3″. Fls. usually tetramerous. Sepals oblong

acuminate ·2–·25″, spreading persistent. Petals cuneate. Anthers cordate. Ovary 3-celled. Fr. (*f. F.B.I.*) globose spongy. The plant in young bud looks very like one of the *Celastraceæ*, but the stipules at once give it away.

All specimens in the *Cal. Herb.* are from S. India and Ceylon.

FAM. 62. COMBRETACEÆ.

Trees or shrubs sometimes scandent, with opp. or sub-opposite, more rarely quite alternate simple exstipulate leaves often with small peltate scales beneath or dots due to cystoliths. Fls. generally small, sometimes polygamous, usually sessile in spikes, heads or in racemes. Hypanthium completely enclosing the ovary and often prolonged above it into a very narrow tube or beak carrying a wider tubular or campanulate 4–6-lobed "calyx-tube." Petals between the lobes, or often 0. Stamens 2-seriate, twice as many as the calyx-lobes or one series reduced or absent. Ovary completely inferior, 1-celled with few pendulous ovules. Style simple. Fruit 1-seeded, generally indehiscent, sometimes 2–5-winged or -angled. Seed exalbuminous, cotyledons usually large and convolute, sometimes three.

Germination appears always to be epigeal, the expanded cotyledons large and broad, often somewhat truncate at the tip and palminerved, petioled.

Characteristic nervation of *Combretaceæ* is penninerved with a number of rather strong sec. n. curved up with the margin and less strong or weak numerous obliquely scalariform tertiaries.

I. Fls. racemose or spicate. Staminodes not present.
  A. Petals 0.
    1. Trees. Sepals deciduous.
      Fls. spiked or racemed. Fr. usually drupaceous . . . 1. *Terminalia.*
      Fls. capitate. Fruit small dry . . . . . . 2. *Anogeissus.*
    2. Large diffuse shrub. Calyx accrescent . . . . 3. *Calycopteris.*
  B. Petals 4–5 (exc. *Combretum apetalum*).
    1. Littoral shrub with alternate leaves . . . . . 4. *Lumnitzera.*
    2. Terrestrial usually climbing shrubs.
      Beak of hypanthium short or under ·5″ . . . . 5. *Combretum.*
      Beak of hypanthium very long. Flowers showy . . 6. *Quisqualis.*
II. Fls. cymose. Staminodes present as glands . . . . 7. *Gyrocarpus.**

1. TERMINALIA, *L.* Myrabolan.

Large trees with sub-opposite, opposite or alternate leaves sometimes clustered at the ends of the twigs and often bearing large glands on the petiole or base of the blade. Fls. small greenish in the axils of caducous bracts in simple or panicled spikes, 4–6-merous. Hypanthium not beaked above the ovary, bearing a campanulate limb or calyx-tube with a hairy lobed disc. St. diplostemonous inserted outside the disc. Ovules 2–3. Fruit drupaceous or dry, endocarp 4–5-angled, or pericarp produced into wings.

I. Fruit drupaceous, not winged.
  A. Leaves alt. and clustered at the ends of the twigs.
    Spikes simple.
    Petioles very short. Fr. glabrous, compressed . . . . 1. *catappa.*
    Petioles 1″. Fr. tomentose globose or pyriform . . . 2. *belerica.*
  B. Leaves not clustered at the ends of the twigs. Spikes panicled. 3. *chebula.*
II. Fruit with 5 (–4) sub-equal wings. Spikes panicled.
    Bark pale. Leaves glabrous . . . . 4. *arjuna.*
    Bark dark, rough. L. usually hairy or tomentose beneath . . 5. *tomentosa.*

* Now transferred to Family Hernandiaceæ.

1. **T. catappa,** *L.* Deshi-badam, Bangla-badam, *Vern.*; Almond Tree.

A very large and handsome tree with wide-spreading crown and buttressed trunk. Bark cracked like that of *T. tomentosa* but less deeply furrowed. Leaves clustered towards the ends of the branchlets 6–10″, obovate with a narrowly cordate base. Spikes solitary axillary. Fruit ellipsoid slightly compressed with a very thick hard and fibrous endocarp 1·7″ long, within which is a small almond hardly worth the trouble of extraction.

Very commonly planted but only thrives in the more humid districts. Fl. March–May with the new leaves which turn a beautiful crimson colour in Jan. and Feb. and then drop.

2. **T. belerica,** *Roxb.* Lupung, *K.*; Lopong, *S.*; Behra, Bahera, *H.*; Bohera, *Beng.*; The Beleric Myrabolan.

A large tree with straight and tall trunk, broadly elliptic and obovate leaves 3–8″ long clustered at the ends of the branchlets (alt. and distant on some growing twigs), petioles 1–2·5″ long, and greenish-white or -yellow flowers ·2–·25″ diam. in solitary axillary or extra-axillary spikes 3–6″ long. Fruit ·75″ diam. grey-tomentose, sub-globose or pyriform showing only faint furrows when dry.

Throughout the whole area, chiefly in mixed forest in the north, general in Sal forest in the Central Area, nearly always in valleys. Fl. March–May. Fr. Jan.–Feb. Deciduous Feb.–March, the new foliage being often copper-coloured.

Bark dark grey, blaze yellow. Leaves with rounded or obtusely-cuspidate apex and cuneate base, only very young with a little pubescence, usually dotted above, sec. n. 6–9 rather irregular, very minutely reticulate between on lower surface. Inflorescence pubescent, sometimes from axils of caducous bracts below leaves. Calyx-tube cupular, densely villous inside, sepals small triangular.

The fruits are used in tanning but have now but little market value. The kernels are eaten but are said to produce vertigo if many are taken. They are largely eaten however by monkeys, and many animals eat the fruits. The tree yields a gum which is eaten by the Santals. As a constituent of "*triphala*" or the three myrabolans, they are used in very numerous diseases by Hindu physicians, especially in hoarseness and cough. There is no distinct heartwood and the timber is little used except for temporary huts. The growth is fairly quick. Two trees sown by me attained 21·9″ girth in 16 years and a height of 36 ft. *Gamble* says that it is moderate to rapid, 3 to 7 rings per inch of radius, and that the wood is used in some parts for house-building after steeping in water.

3. **T. chebula,** *Retz.* Rola, *K.*, *S.*; Hadra, *Uran*; Hara, Hara-taki (the fruit), *Beng.*; Kasa-phal (Mayurbanj); Harida, *Or.*; The Chebulic Myrabolan.

A small or m.s. tree with a rounded crown, usually sub-opposite ovate or elliptic leaves 4–7·5″ by 2–4″ and whitish flowers in spikes from the upper new leaf axils and forming small terminal panicles. Drupe ellipsoid 1–1·25″ long glabrous, 5-ribbed when dry due to the 5-ribbed endocarp.

Throughout the whole province, especially common on the low hills and plateaux and ascending to the highest points. It appears to favour clay soils. Fl. April–May with the new leaves. Fr. Nov.–Feb. Decid. Feb.–March.

Trunk usually short and crooked, bark grey or dark-grey, in old trees cracked and flaking, blaze thick hard, deep grey-brown on the outside then yellow or sometimes an intermediate reddish zone. Young shoots and leaves usually beautifully silvery-silky, adult nearly or quite glabrous, acute or obtuse with a rounded rarely acute base and 7–9 prominent oblique slightly arched sec. n., nervules very finely reticulate as in other species. Petiole ·5–1″ with usually 2 glands near the top. Spikes 2–3·5″, pubescent or tomentose. Bracts linear as long as the buds, caducous.

Fls. very densely white-villous within. Stone 5-angled, very thick with gum vessels in the walls and convolute cotyledons.

There are several varieties or forms, chiefly dependent on the amount of pubescence. In one the hypanthium is densely villous, in another glabrous; the villous one is far the commoner. In Mayurbhanj a form occurs with the leaves nearly glabrous from the first, while on Parasnath a form occurs with the leaves shaggy beneath and the drupes only ·75″ long.

It is the best of the Myrabolans for tanning, and the best quality is considered to be those "nuts" (so called in the trade) with a bright orange colour (this has, however, been denied); they are best collected off the ground as soon as they fall.

The tree is a great light demander, at least for good fruit-bearing, though the seed germinates best in shade. It is frost-hardy and coppices well. The growth is rather slow, but ·7″ girth increment p.a. has been recorded in Singbhum. The fruit is largely eaten by animals, especially Chital. *Hari-taki* is the chief Myrabolan in Hindu medicine and is highly prized as an alterative and tonic.

4. **T. arjuna,** *W. & A.* Kowa, Gara Hatana, *K.*; Kahua, *S.*; Kahua, *Kharw.*; Arjun, *H.*

A large tree with pale greenish or grey bark, long inclined branches with opp. or sub-opp. oblong leaves 2–3-times as long as broad, but smaller ones at bases of shoots elliptic, sub-sessile, soon glabrous. Flowers ·2″ diam., white, in shortly panicled spikes. Fruit 1-1·5″ long, wings less than ·5″ wide, usually premorse above, with ascending striations.

Common along nalas where it sometimes attains an immense size in the Central and Southern areas. Not noted from the Northern area and not very common in the Santal P., also rare or absent in Puri, Balasore and Cuttack. It thus chiefly occupies the valleys of the dryer hilly districts. Fl. May–July. Fr. March–April. Evergreen or nearly so, renewing its leaves at the time of flowering.

Attains 12 ft. girth and 100 ft. in height with smooth bark or slightly flaking on old trees and deep red or crimson blaze distinctly zoned. Leaves with 2 glands near the base or on the very short petiole which is under ·5″, margin entire or crenate but nerves not excurrent as teeth.

Seedlings have often toothed and usually linear-lanceolate glabrous leaves and there are often 3 cotyledons which are very broadly cuneate, ·7–1·8″ diam. at apex, with slender ·5–·7″ long petioles. Two trees which were sown by me attained in 16 years an average height of 38·5 ft. and girth 34·2″. The timber a good deal resembles that of *T. tomentosa* and is used for building and agricultural implements, but the chief use of the tree latterly has been for the bark, which is good for tanning and can be removed, *i. e.* the outer bark, which is the best, without damaging the tree.

Gamble gives the weight of the wood as 52–69 lbs.

The bark is also used in native practice as a tonic and astringent and is said to be useful in heart diseases, contusions and ulcers.

5. **T. tomentosa,** *W. & A.* Hatana, atana, *K.*, *S.*; Asana, *Th.*; Saj, Asan, Sain, *H.*

A large tree with dark cinereous rough bark, deeply cracked into oblong segments, opp. or sub-opp. elliptic or ell.-ovate or, in some varieties, oblong leaves 5–9″ long, entire or nerves excurrent as teeth, subsessile or petioled with distinct tertiary nerves, under-surface permanently pubescent or with a close felted tomentum or in one variety glabrescent. Two large glands beneath or on the petiole. Flowers and panicles much as in *T. arjuna* but panicles often larger. Fruit 1·5–2″ long or sometimes attaining 3″ by 2·5″, wings over ·5″ broad with horizontal striations.

Throughout the whole area and perhaps the commonest tree. It is partial to the more humid valleys and only there attains its best development, but appears as a

small tree on the hills and plateaux. Fls. May-June. Fr. Feb.-March. Decid. March-May.

As might be expected in so widely distributed and common a tree, there are several forms or varieties:

Var. *α* **nepalensis.** Ujar-ki-Asan, *Th.* Leaves large, usually oblong, 8–11″ long, with a very close short tomentum beneath whence the under-surface appears white or grey. Sec. n. over 20 with oblique scalariform tertiaries. Inflorescence tomentose or closely shortly pubescent, bracts linear-subulate. Fls. ·16–·17″ diam. Hypanthium tomentose slightly longer than broad, calyx outside thinly pubescent or almost glabrous at tips, sepals triangular mucronulate, inside with long villi and large lobed disc densely villous-hirsute.

Lower hills and valleys of the Northern Area, entering Nepal. The sawyers say that the wood is lighter coloured and superior to that of the ordinary Saj. Whether this is the same tree as var. *coriacea, Clarke*, of the Coromandel Coast I am unable to say without further specimens.

Var. *β* **typica,** *Clarke.* The Central India Saj. Leaves usually more or less elliptic-oblong or ovate, often serrate esp. when young, hairy beneath esp. on the nerves. Sec. n. usually fewer than 20. Inflorescence with a looser longer indumentum but flowers ·18–·19″ diam. with the sepals inside far more *shortly* villous, deltoid; hypanthium broader than long, densely pubescent; calyx outside pubescent or hairy. Disc much as in last.

The Common Saj or Hatana of Chota Nagpur and the Central Provinces. The fruit is often very large and always glabrous.

There are other forms, including one which is very nearly glabrous in the Santal Parganas, and there are also what appear to be hybrids between this species and *T. arjuna.* The seedlings of *T. tomentosa* are usually toothed and hairy.

The tree is very easily grown from seed and appears to prefer a clayey loam. It is more patient of water-logging than most trees. In coppicing it throws out far too many shoots from the top of the stump which are apt to remain weak unless thinned out. In unfavourable localities seedlings may apparently take some twenty years to form a stem and this is frequently a sympodium. Seed sown by me in Singbhum grew on an average 30 ft. in height and 20·9″ girth in 16 years and were thus much slower than the *Arjun.*

The timber of *T. tomentosa* is very useful and has been largely cut for sleepers (which are, however, far inferior to Sal), as well as being one of the principal trees used as poles in native houses. It is also an excellent fuel. *Gamble* gives the weight as about 52 to 70 lbs. It is the tree pollarded throughout Chota Nagpur for feeding the Tusser Silk-worm. The bark appears inferior for tanning to the last. The young ovaries are attacked by a cynips, so that panicles of galls are very common on the tree, which are sometimes mistaken for fruits.

2. ANOGEISSUS, *Wall.*

Trees or shrubs with opp. or sub.-opp. and alternate entire usually dotted petioled leaves and small greenish flowers in globose axillary peduncled heads. Ovary inferior and hypanthium produced above it into a beak and then into a campanulate 5-lobed "calyx-tube." Petals 0. St. 10 in two series adnate to the campanulate tube outside the crenate hairy disc. Ovules 2 pendulous. Fr. small indehiscent compressed, 2-winged, beaked, in densely packed heads. Germination epigeal but hypocotyl very short, cotyledons transversely oblong sub-reniform, petioled, convolute in the seed.

Bark smooth pale. Leaves broadly elliptic, obtuse both ends . . 1. *latifolia.*
Bark dark. Leaves elliptic acute, one or both ends . . . 2. *acuminata.*

1. **A. latifolia,** *Wall.* Hesel, *K., S.*; Dhaunta, *Kharw.*; Dhaura, *H.*; Bhanji, *Th.*

A straight large or m.s. tree with whitish bark and alt. to opposite usually broadly elliptic leaves 2–4″ long rounded or obtuse at both ends, in most cases glabrous with age. Peduncles usually shortly racemed or 2–3-nate. Fruit (excluding beak) about as long as broad rarely ·25″, beak equalling or shorter than the diam. of the fruit, at length deciduous.

In the Northern Area chiefly on dry ridges in the west, absent from the eastern districts. In the Central Area very common, forming a large proportion of the growing stock on the dryer hills and also frequent in second growth, also common in the Southern Area except on the coast. Fl. June–Sept. Fr. Dec.–Jan., rarely up to the end of March. Deciduous Feb.–April. Leaves turn red or brown in December.

Bark smooth, shed in thin roundish flakes, blaze first a chlorophyll layer, then brown-pink, inside (on wood) pale brown. Leaves sometimes sub-orbicular or emarginate, rarely acute, with 8–14 distinct sec. n. curved before reaching the margin, pellucid dots visible with a lens from above but often not from beneath. Petiole ·25–·75″. Heads (without st.) ·3″ diam. Wings of fruit entire or angled but not jagged.

Var. **tomentosa,** *Haines* (*F.C.N.*). Twigs and leaves, especially beneath, persistently tomentose (but not smaller as in *Clarke's* variety *villosa*). Fruits slightly puberulous above, only about as broad as long and beak as long.

Manbhum, Palamau, and west of Hazaribagh!

The tree is a very useful one and is especially in request by the agriculturist for posts, implements and carts. Axles are manufactured out of large trees as well as from poles. In the Monghyr market it commands the best price of all woods as fuel. It is very strong, tough and elastic, but the values given for P in *Gamble's Manual* vary from 752 to 1220. *Troup* includes it only in his fourth class in which P = 700–800. Weight 56–68 lbs. (*Gamble*).

The twig, bark and leaves have assumed considerable importance during the war for tanning purposes. According to *Mr. Fraymouth* the September shoots are better than those produced in other months. A scheme for pollarding has been proposed to yield several flushes of shoots and leaves in the year. Several notes on reproduction are given in *Mr. Tireman's* paper before the Tannin Conference. I have germinated seed fairly easily on heaps of rubble, and in the forest natural clearances caused by land-slips and with some lateral shade are often thickly covered with seedlings. The cotyledons are ·5–·6″ diam. with petioles ·2–·4″ and the young seedlings are very hairy. Trees raised in Chaibassa from seed had an average height of 30 ft. 10″ and girth 18·9″. *Gamble* gives 7 rings per inch of radius for the growth and more details are given in the paper cited. The young trees coppice fairly well in the hot season. *Mr. Makins* has recorded 5-year-old coppice 16 ft. high and 9″ girth. It is fairly frost-hardy.

2. **A. acuminata,** *Wall.* Gara-hesel, Parsia, *K.*; Chakwa, *Beng.*; Phansi, *Or.*

A large and beautiful tree with slender drooping branches but often flowering as a small tree. Leaves ·75–2·25″ long, mostly sub-opposite, narrowly elliptic or elliptic or elliptic-oblong, acute one or both ends and apiculate, base nearly always cuneate, beneath densely sericeous when young more or less glabrescent with age and old leaves glabrous above, sec. n. 5–8 or up to 12 on the longer leaves, fine and distinct. Peduncles mostly solitary from the leaf scars and axils. Hypanthium above and beak densely pubescent, calyx-tube glabrous without. Fruit ·13–·18″ long and ·24–·28″ broad with upper part

pubescent and beak much shorter than diameter, wings often lobed or irregularly cut and angled or toothed.

Central and Southern areas, along rivers and streams. Singbhum, not uncommon and attaining 8 ft. girth in Saranda! Athmallik! Mayurbhanj! Puri! to Sambalpur! Frequent along the Mahanadi. Fl. March–April. Fr. April–May. Evergreen or nearly so, renewing its leaves at the time of flowering or fruiting at which time the old ones are also shed.

Attains 8 ft. girth with nearly black cracked bark and red blaze. Young parts densely sericeous or tomentose. Leaves often rounded at the tip but apiculate and with cuneate base, rarely base obtuse and only in some leaves, dots appearing translucent and due to crystal-cells are numerous. Peduncles usually solitary but in one form clustered and branched; they sometimes appear panicled by arising on leafless twigs.

The wood is used for cart axles and ploughs and some natives state that it is superior to that of *A. latifolia*. *Gamble* states that it is inferior to that tree and that it warps and cracks in seasoning; he gives the weight as about 50 lbs.

3. CALYCOPTERIS, *Lamk.*

A shrub with opp. entire leaves with minute scales beneath and greenish flowers in dense axillary and panicled spikes or racemes. Flowers with a tendency to zygomorphy, the style being always declinate towards the posterior sepal. Hypanthium 5-angled expanded above the ovary into a campanulate "calyx-tube" without a disc, villous both inside and out with 5 large sepals and 10 stamens in two series. Petals 0. Ovules 3–5 on long funicles. Fruit crowned by the greatly enlarged wing-like sepals. Cotyledons convolute.

1. **C. floribunda,** *Lamk.* Sil, *Or.* (also Achindi and Atundi, through confusion with Combretum); Kukaranji, *Gondi.*

A large sarmentose or climbing shrub attaining 18″ girth with rusty villous shoots, opposite ovate or elliptic acuminate leaves 2·5–5″ long copiously covered with minute peltate scales beneath, densely tomentose when young and pubescent rarely quite glabrescent when old. Flowers villous in dense bracteate spikes or sometimes with short pedicels, ·26″ long in flower with sepals ·15–·17″ long, spikes in large terminal panicles. Calyx rapidly enlarges after flowering with membranous sepals ·5–1″ long crowning the 5-ribbed indehiscent 1-celled fruit which is villous and ·3″ long.

In the Southern tract only. Mals of Puri! Angul, common! Narsingpur, common! Fls. March–April. Fr. May.

Leaves with rounded base and about 9 sec. n. curved up within the margin and with not very strong scalariform tertiaries, usually permanently pubescent on the nerves beneath. Petiole ·1–·2.″

It is curious that no work which I have seen makes mention of the very characteristic scales, which resemble those of a *Combretum*.

4. LUMNITZERA, *Willd.*

Large shrubs or small trees growing in salt marshes, with alternate coriaceous subsessile entire or crenate obovate leaves and narrow flowers in spikes or racemes with small bracts, and two bracteoles adnate to the hypanthium. Hypanthium narrow tubular, solid for some distance above the ovary and then produced as a funnel-shaped calyx-tube with small sepals. Petals 5 inserted in the throat of the calyx-tube. Stamens 10, or the anti-petalous ones failing. Ovary

1-celled with simple style sometimes adnate to one side of the calyx-tube. Ovules 2–5 pendulous. Fruit woody, crowned by the calyx-tube. Radicle long, only partly enfolded by the convolute cotyledons.

1. **L. racemosa,** *Willd.* Tunda, *Or.*

A small tree with rough bark and small obovate or oblanceolate entire or crenate fleshy leaves 1·5–2″ long. Flowers small white ·25″ diam. in mostly axillary spikes.

Tidal forests of the Mahanadi delta! Fl. April-May. Fr. May-June.

Leaves with a long cuneate base and rounded or emarginate apex, venation obscure. Hypanthium and calyx together ·3″ long, lobes small rounded minutely ciliolate. Petals entire ·12″ ell.-obovate. Fruit ·5″ (in May and not quite ripe) bottle-shaped, clasped at the base by the two oblong-spathulate bracteoles, striate.

5. COMBRETUM, *L.*

Usually large sarmentose shrubs (*C. nanum* is a dwarf shrub) with opp. or sub-opp., more rarely alternate, entire leaves, often with small peltate scales beneath. Flowers small white or greenish in our species (showy in some exotics) in spikes or racemes which are usually panicled, sometimes with large white petaloid bracts, polygamous. Hypanthium constricted above the ovary, expanding into a tubular or urceolate "calyx-tube" above it, and sometimes with an intermediate very narrow tube or beak, sepals small 4–5, petals as many or 0, stamens twice as many, 2-seriate. Disc usually lining the calyx-tube with villous margins within the stamens. Ovary with 2–5 pendulous ovules. Fruit with 4–5 angles or wings, dry. Seed one, with flat or plicate rarely convolute cotyledons.

A. Flowers 5-merous. Fruit 5-winged . . . . 1. *decandrum.*
B. Fls. 4-merous. Frt. 4-winged.
  Large sarmentose shrub or climbing shrub . . . . . 2. *ovalifolium.*
  Undershrub . . . . 3. *nanum.*

NOTE.—*C. extensum, Roxb.*, is quoted in *Bengal Plants* from Chota Nagpur. The supposed specimen, collected by *Dr. Wood*, is in the Calcutta Herbarium and is merely *Terminalia chebula.*

1. **C. decandrum,** *Roxb.* Phalandu, *K.*; Aten, *S.*; Kateng, *Kharw.*; Atundi, Kala-Achindi, *Or.*

A large bush or scrambling climber or twining from left to right, sometimes covering the highest trees and conspicuous from the large white bracts on the inflorescence. Leaves coriaceous oblong shortly suddenly acuminate 3–5″ long rarely 7″ by 3″, shining above, glabrous or somewhat appressed hairy or with tufts of hairs in the axils of the strong sec. n. beneath. Spikes rusty villous ·5–1″ rarely 2″ long in large axillary and terminal panicles. Fls. 5-merous with urceolate calyx-tube ·17″ diam. densely villous-pubescent. Frt. oblong or elliptic 1–1·25″ long.

Very common throughout the province, especially along nalas but also forming dense low masses in scrub jungle, as in Gaya. Fls. Nov.—Feb. Fr. April-June. The leaves on the panicle turn white or cream-coloured in November while the flower buds are unopened. Evergreen.

Sometimes forming a dense bush in the open with brown bark. Innovations densely rusty-villous. Leaves sometimes somewhat obovate-oblong, sec. n. 6–8, tertiaries subscalariform, those on the panicle similar except as to colour and texture, bracts on the spikes becoming linear upwards, villous. Sepals sub-aristate, acuminate, petals ovate acuminate hairy, not much longer.

2. **C. ovalifolium,** *Roxb.* Atundi, *Or.*

A large climbing shrub with elliptic or oval, not at all oblong, leaves 2·5–4·5″ long, apex rounded or with a very short obtuse cusp. Spikes ·5–1·5″ rarely 2″, often racemose on a common rhachis and frequently by the fall of the leaves appearing copiously panicled. There are no white foliaceous bracts on the panicle.. Fruit 4-winged only, often a beautiful claret colour when ripe, ·75–·9″ by ·6–·7″, shining, with numerous close horizontal striæ.

Chota Nagpur, rare (Palamau, Rajkot)! Puri, fairly frequent!! Angul! Palamau! Fls. Feb.–April as the leaves are dropping. Fr. May. Deciduous for a short time, renewing leaves in May, often a beautiful dark red before falling.

Very young leaves have a dense villous tomentum near mid-rib and lower sec. n., mature with a rounded or shortly cuneate sometimes unequal base, sec. n. 6–8. The under surface of the leaves shows under a lens numerous minute discs evidently corresponding to the scales so evident in some species but in this case scarcely differentiated from the rest of the leaf surface. Petiole ·4–·7″ Fls. usually dense towards the end three-fourths of short lateral branches of panicles 2–2·5″ long which arise in the axils of falling or fallen leaves, and are pubescent. Petals rather shorter than the 4 triangular acute sepals and narrowly obovate with sometimes retuse apex. Disc densely hairy. There are two forms:

α. Hypanthium below the calyx-tube ·14″ long and pubescent.

β. Hypanthium below the calyx-tube ·09–·1″ long glabrous and varnished.

In both forms it is slightly narrowed upwards and 4-angled.

Var. **Cooperi,** *Haines.*

This is a remarkable plant but too fragmentary to describe. The leaves are exactly those of *C. decandrum* except that it has the scales characteristic of but more pronounced than in *C. ovalifolium* and one of the lower leaves has also the shape of the latter species. The plant is in fruit with pubescent axillary panicles 3–4·5″ long. Fruits all 4-winged but *oblong* 1·8–1·9″ long by ·75–·8″ with red colour and texture of *C. ovalifolium* and minute scales between the wings as in that species.

The plant is described as a climber and might very well pass as a hybrid between *C. decandrum* and *C. ovalifolium.* Kalahandi, *Cooper*!

3. **C. nanum,** *Ham.* Phirtol-rel, Andaika, *K.*

An undershrub with woody rootstock, and numerous erect stems or branches 1–2 ft. high, opp. or alternate leaves which are orbicular or obovate or lanceolate 2–4″ long and are at first bright red and again turn brilliant red in December and January. Petiole ·5″. Flowers white in rather dense racemes 4–8″ long. Hypanthium obconic. Petals far exceeding the sepals. Fruit 1–1·5″, a pretty pink or crimson, 4–winged.

Burnt jungles and fire-lines more especially on the plateaux. Throughout Chota Nagpur! Gaya (on the ghats and hills)! Fl. with the new shoots March–May. Fr. April–Aug. Deciduous Jan.–Feb. and in unprotected forest usually burnt down by the jungle fires.

6. QUISQUALIS, *L.*

Quisqualis is chiefly distinguishable from *Combretum* by the hypanthium produced into a very much longer slender tube above the ovary and the style partly adnate to the tube, funicles long with their papillose inner sides almost connate. Flowers showy.

1. **Q. indica,** *L.*

A large handsome climber with elliptic-oblong shortly acuminate leaves 3–4″ long, petiole ·3–·4″ at first, persistent and often transformed into recurved spines after the fall of the leaf and by which the plant is assisted in climbing. Flowers showy in terminal racemes with bracts ·3–·4″, hypanthium about 3″ long, petals ·8–1″ at first white then changing to red and crimson. The flowers are beautifully scented of an evening.

Very common in gardens. Indigenous in the Malay Peninsula, Philippines and western tropical Africa.

The genus *Gyrocarpus* is transferred to Hernandiaceæ.

FAM. 63. MYRTACEÆ.

Trees or shrubs with opposite, very rarely alternate, exstipulate, simple entire, usually evergreen and shortly petioled leaves which with the young stems and parts of the flower and fruit are usually copiously supplied wish lysigenous oil glands. Flowers 2-sexual regular perigynous or epigynous, the hypanthium adnate with the ovary and often produced into a tube (calyx-tube) above it. Sepals 4–5 imbricate usually persistent. Petals rarely 0, inserted on, or on the margin of the epigynous disc, or disc lining the hypanthium. Stamens usually numerous and many-seriate inserted with the petals, filaments free or variously connate, anthers small with longitudinal dehiscence, usually dorsifixed. Ovary syncarpous 2–many-celled with axile placentation, rarely 1-celled and placentation basal. Ovules usually numerous anatropous or campylotropous, sometimes only 2 or 1. Fruit various, baccate, drupaceous or opening by as many valves as there are cells. Seeds usually 1-few, exalbuminous, embryo straight or curved.

Germination usually hypogeal.
The venation of the Myrtaceæ is like that of the Combretaceæ or more usually the sec. n. loop continuously within the margin or join an even intramarginal nerve.
The Lecythidaceæ (including *Careya* and *Barringtonia*) are included in the *F.B.I.* and many other works in this family.

I. Fruit baccate.
  A. Cotyledons thick and fleshy. Sep. 4. Seeds 1-few . . 1. *Eugenia.*
  B. Embryo horse-shoe shaped. Cotyledons small with comparatively large hypocotyl.
    Fls. axillary solitary. Sepals free in bud . . . . 2. *Myrtus.*
    Flowers paniculate cymose . . . . 3. *Pimenta.*
    Peduncles axillary 1–3-fld. Calyx entire in bud irregularly splitting in flower . . . . 4. *Psidium.*
II. Fruit dry, loculicidally splitting at top.
  Fls. capitate or umbelled. Petals calyptrate . . . . 5. *Eucalyptus.*
  Fls. in axillary spikes. Petals 5 spreading. St. in bundles opposite the petals . . . . 6. *Melaleuca.*
  Fls. in proliferous spikes. Stamens free . . . . . 7. *Callistemon.*

1. EUGENIA, *L.*

Trees or shrubs with often quadrangular branches and usually opposite glabrous gland-dotted leaves. Flowers sometimes solitary axillary but usually in 3-chotomous cymes. Hypanthium often produced into a calyx-tube above the ovary which is truncate or with 4–5 sepals. Petals 4 rarely 5, sometimes calyptrate. Stamens with

small versatile anthers often with a gland at the tip. Ovary 2-rarely 3-celled, style simple. Ovules many in each cell but only 1-few developing. Embryo thick with short axis and large fleshy cotyledons. Germination hypogeal.

I. Flowers cymose. Hypanthium produced beyond the ovary as a calyx-tube.
  A. Stamens not inserted on a thickened disc. Petals usually calyptrate (*Syzygium*).
    1. Secondary nerves and intermediate very fine close and numerous.
      a. Branches of panicle rounded in section.
        L. oblong or ell.-oblong over 4″ not glaucous, glands conspicuous. Berry oblong or ellipsoid . . . 1. *jambolana.*
        L. ell. or lanceolate mostly under 4″, glands obscure. Berry pisiform . . . . . . 2. *caryophyllifolia.*
        L. narrowly oblong or lanceolate. Berry dry oblong or ovoid. Often shrubby, glands very conspicuous . . . . 3. *Heyneana.*
      b. Branches of panicle square in section.
        Branches of panicle sharply 4-angled. L. of *Jambolana* not glaucous, glands more evident, surface often shining . . . . . . 4. *fruticosa.*
        Branches of panicle obtusely 4-angled. L. broadly ell. to ell.-oblong 2·5–5″ dull and very glaucous . 5. *glaucissima.*
    2. Sec. n. 8–15 distinct and raised beneath . . . 6. *operculata.*
  B. Stamens inserted on a thickened disc. Petals not usually calyptrate. Flowers often large (*Jambosa*).
    1. Angles of twigs decurrent into a sac above the nodes Large indigenous tree. Petals sometimes calyptrate 7. *lanceæfolia.*
    2. Angles of twigs not saccate at the extremities. Small cultivated trees.
      Flowers 2–3″ diam. Fruit globose . . . . . 8. *jambos.*
      Fls. 1·5″ diam. Fruit shining turbinate . . . 9. *javanica.*
II. Flowers solitary or sub-racemose. Hypanthium not produced into a tube above the ovary (*Eugenia* proper). Shrub . . . . 10. *bracteata.*

1. **E. jambolana,** *Lamk.* Jamun, Jam, *H.*; Kala Jamb, *Beng.*; Jamkuli, *Or.*; Kuda, *K.*; So-kod, *S.*; Jambun, *Ur.*

A large tree everywhere glabrous with oblong or elliptic-oblong acute or acuminate shining leaves mostly 4″ or more long, with very numerous close spreading sec. n. and intermediate nearly as strong. Fls. white sessile mostly in threes in 3-chotomous panicles with terete branches. Hypanthium turbinate ·1–·2″ long, sepals 0 rarely small. Petals calyptrate. Berry ellipsoid or oblong, often curved.

Very common throughout the area, wild or cultivated. The wild tree occurs chiefly along rivers and nalas. Fl. May–June. Fr. June–July. Evergreen and renews leaves about the time of flowering though the inflorescence usually appears on the previous years' twigs.

Attains 8 ft. girth or more in sheltered ravines, with grey-brown or nearly black often pitted bark more or less cracked when old. The trunk is nearly always single. Blaze thick, deep red or brown. Wood reddish-brown to reddish-grey.

Seed nearly always solitary with thick rounded fleshy cotyledons closely appressed on their inner faces. Seedling stems sharply 4-angled with linear or lanceolate leaves ·4–1·5″ long in their first year, alternate or opposite, without the close fine nervation of the adult.

Timber good and has latterly been much used for sleepers. It is also used for building and for well-curbs, agricultural implements and carts. It is a very good heating fuel. Weight 40-50 lbs. The fruit is eaten and a preparation is given as a stomachic, as a remedy in enlarged spleen and in chronic diarrhœa. The bark is also used for diarrhœa and dysentery and the seed in diabetes. It is a very good avenue tree except in very dry situations.

The following species, nos. 2–5, should in my opinion be all treated as varieties of *E. jambolana* or all treated alike as species. It is usual to treat *E. fruticosa* and *E. Heyneana* only as species. The two hill trees *E. caryophyllifolia* and *E. glaucissima* can be distinguished in the forest without any difficulty whatever, whereas it is sometimes very difficult to discriminate between *E. fruticosa* and *E. jambolana* without inflorescence. In the herbarium they are always recognised by the inflorescence.

2. **E. caryophyllifolia,** *Lamk.* Syn. E. jambolana var. caryophyllifolia, *F.B.I.*; Buru-kuda, *K.*; Bir-kod, *S.*

A small or m.s. tree with pale branchlets, ell. or lanceolate or ovate lanceolate acuminate leaves mostly under 4″ long, the glands very small and inconspicuous. Fls. white sessile but often sub-pedicelled with much contracted base, usually clustered at the ends of the branches of short 3-chotomous or irregularly branched panicles with terete branches. Bracts among the flowers caducous linear-subulate. Hypanthium turbinate ·1–·15″. Sepals small rounded. Petals calyptrate. Berry pisiform.

Hills of Chota Nagpur, very common. Fl. May. Fr. June. Nearly leafless at the time of flowering; the young leaves then all come out together generally of a brilliant red colour.

3. **E. Heyneana,** Wall. Gara-kuda, *K.*; Chuduk' Kod, *S.*; Kat-jaman, *Kharw.*

A shrub or small bushy tree 8–20 ft. high with narrowly oblong-elliptic or lanceolate acuminate leaves 3–5″ by ·5–1″ and lateral cymes of capitate white flowers from the old twigs. Berry ·5″ oblong crowned by the calyx-tube.

Along streams. Champaran! Common in Chota Nagpur! Frequent in the Southern Area and probably in all districts except perhaps on the coast. Fl. May–June. Fr. July–Aug.

Leaves have glands more evident than in *E. jambolana* and the cymes are usually longer-peduncled, 2–3″ long with brachiate branches. Fls. sub-sessile usually several in a head, sepals small.

A form collected by me on the Mahanadi in Angul has linear-lanceolate leaves only 1–2″ long. The presence of the calyx-tube on the fruit is not a specific distinction; it occurs even in the cultivated forms of *Jambolana.*

The fruit is sometimes said to be eaten.

4. **E. fruticosa,** *Roxb.* Bhalu Jamun, *Or.*

A large tree* but usually branched low or from the base with leaves closely resembling those of *E. jambolana* often long acuminate very distinctly glandular, shining or not. Fls. as in *jambolana* in short panicles but with sharply 4-angled branches. Bracts among the flowers minute very caducous. Hypanthium turbinate or broadly campanulate. Sepals 0. Petals calyptrate or *sometimes expanding.* Fruits globose ·25–·3″ diam.

Mountains of Mayurbhanj 2500-3500 ft. Fl. May–June. Fr. July. Ev. Renews leaves from February onwards.

Bark pale grey, in young trees with chlorophyll, dark grey or with pale patches and somewhat cracked in old trees. Blaze brown as in *Jambolana.* L. usually narrow ell. and acuminate with dots conspicuous beneath when dry, 3–5·5″.

---

* It is described as a shrub by *Roxburgh*, but all the specimens in the Calcutta Botanic Garden have grown into trees. There are several other cases of Chittagong plants being found in Orissa (see Introduction).

Petioles ·5–·9″, divaricate. Fls. usually very small, ·1″ only, but in Mayurbhanj specimens ·15 by ·2″ with raised glands inside and out. St. ·2″ long. Fruits (in Maymyo specimens) globose ·3–·35″ diam.

5. **E. glaucissima,** *Haines.*

A small tree with broadly elliptic to ell. oblong long-acuminate leaves 2·5–5″, rarely attaining 7″ and oblong lanceolate, very glaucous and not shining, with very conspicuous pellucid dots. Fls. white sessile ternate or clustered at the ends of the short branches of rather irregular panicles with 4 sided but not sharply 4-angled branches. Bracts among the flowers caducous minute obtuse or acute oblong or triangular. Hypanthium obconic then saucer-shaped ·15″ long and broad. Sepals 0. Pet. calyptrate. Berry sub-globose (excluding the short truncate tube) or broadly ellipsoid, glands in the pericarp large and numerous.

Hills of Chota Nagpur 2000–3000 ft.! Fl. May. Fr. June. Evergreen.

Bark pale. Blaze rather hard, light red in young, deep red in old trees. Petiole ·5–·7″. Cymes from previous years' leafless axils stout, ·5–1·5″ with few branches.

Regarded as a variety it is not clear whether this is most nearly allied to *E. jambolana* or to *E. fruticosa*.

6. **E. operculata,** *Roxb.* Topa, *K.*; Totonopak', *S.*; Paiman, *H.*; Bodara, *Th.*; Satiam, Bawal, *Or.*; Pui Jamla, *Gond.*; Dumkol (Gaya).

A low tree with broadly elliptic or obovate and rounded leaves 5–7·5″, more rarely oblong-oblanceolate or ovate and acuminate, sec. n. rather irregular 7–12. Fls. white sessile ternate in brachiate panicles 3–6″ long mostly from old leaf scars. Berry glabrous ·25–·3″ (–·5″, *F.B.I.*).

Widely distributed in the damper forests but not common except in the north. All along the northern boundary esp. in Purneah in open grassy jungle tracts! Valleys in Singbhum, Hazaribagh, Manbhum and Santal P., especially in grassy glades! Ranchi ghats, near streams! and the cool tops of the highest mountains, *e.g.* Parasnath and Meghasani! Gaya, at foot of ghats! Angul! Sambalpur! Fls. April–May. Fr. June–July. The leaves turn red before falling.

Bark rather rough, blaze red. Twigs 4-angular. Leaves usually 2·5–3·5″ wide or, in one form occurring in Chota Nagpur, 1·75–2″ wide only, dots small. Petiole ·5–75″. Hypanthium obconic ·15–·18″ long and broad. Sepals 4, transversely oblong, glandular. A large gland also on connective.

The fruit is eaten for rheumatism and an extract of the root boiled down to the consistency of gur is rubbed on the joints for the same disease while the leaves are used in dry fomentations. The tree is seldom straight and the wood usually used only for agricultural implements. Weight 45–50 lbs.

7. **E. lanceæfolia,** *Roxb.* Syn. E. Wallichii, var. lanceæfolia, *F.B.I.*

A large tree with smooth nearly white bark, twigs 4-angular above the nodes with distichous oblong or lanceolate acuminate glabrous leaves 3–7″ long, shining above, and white flowers in lateral corymbose cymes 1·5–2·5″ long and broad. Berries narrow oblong crowned with the calyx. The most characteristic feature of the species, however, is the way in which the two pairs of internodal ridges unite and form two prominent sacs above or at each node.

Mayurbhanj, Simlipahar Range, elev. 3000 ft. in dark valleys! Fl. Nov.–Jan. Fr. Feb. Evergreen.

Large trees are much buttressed below, blaze hard with chlorophyll, then dark red. Leaves translucent-dotted seen from beneath and with minute yellow glands, acumen often very slender, base rounded, obtuse or acute, sec. n. about 12 scarcely stronger than intermediate, others fine and reticulate. Petiole ·3–·5″. Cymes corymbose, axillary, 1·5–2·5″ Hypanthium ·2″, turbinate, sepals broad, semi-orbicular. Petals usually calyptrate. St. ·4–·5″ long. Berry ·4″ oblong, contracted into a neck below the persistent calyx.

The distribution of this fine tree outside our area is from the Duars to Assam and Chittagong. *Roxburgh* says of it, "I am inclined to consider this one of the most elegant and most useful species of this genus."

8. **E. jambos,** *L.* Syn. Jambosa vulgaris, *DC.*; Gulab-jamun, *H.*; The Rose-apple.

A small tree with lanceolate leaves 5–8″ long narrowed into a short petiole, sec. n. rather distant joined by a prominent looping intra-marginal one. Easily recognised by its very large handsome flowers about 3–4″ diam. (with the long stamens) and which are in short terminal racemose cymes with pairs of flowers (trichotomous cymes with the central axis not at once terminating in a flower). Sepals rounded. Fruit globose white 1–2″ with 1–2 grey seeds loose in the large cavity of the succulent pericarp.

Very commonly cultivated and semi-wild in the village jungles of Purneah, also cultivated in Santal Parganas, Balasore, etc., but does not succeed well in the dryer districts. Fl. March–April and fruits in the r.s.

The fruit has a sweetish rose-water flavour and is very indifferent eating.

9. **E. javanica,** *Lamk.* Syn. E. alba, *Roxb.*; Jamrul, *Beng.*

A small tree with oblong acuminate sub-sessile or very shortly petioled leaves 5–10″ long with a narrowly cordate or sub-cordate base and conspicuous nervation. Flowers not nearly so handsome as in the last, about 1·5″ diam. or 2·2″ with the stamens, in lateral and terminal short cymes and often from the old branches and trunk. Staminal receptacle somewhat pulvinate with a yellow colour. Fruit turbinate almost flat above rather a pearly or pinkish white crowned by the fleshy inflexed sepals, very watery and flavourless.

Cultivated only in the southern moister districts, *e.g.* Cuttack. Fl. April. Fr. May. Native of Malacca.

10. **E. bracteata,** *Roxb.* Sagarabatua, Unchana, *Or.*

A pretty myrtle-like shrub 2–4 ft. high with leaves 1·5–3″ very faintly nerved (until dried). Flowers ·4–·7″ diam., white, usually solitary extra-axillary but often appearing terminal (being crowded on the new shoots with undeveloped leaves). Berries red or ultimately black globose 1–2-seeded about ·3–·4″ diam. crowned by the 4-leaved calyx.

Very common on sandy ground in Orissa near the coast from Cuttack southwards and often in the laterite scrub jungle! Fl., Fr. all the year round.

Twigs brown. Innovations brown-hairy as well as the inflorescence. L. lanceolate, oblanceolate, elliptic or rhomboid usually contracted at the base, apex obtuse subacute or acuminate, copiously gland-dotted. Petiole ·1–·2″ Pedicels ·3″ Calyx with a circular brownish pubescent disc. Sepals 4 oblong obtuse ·15″ long somewhat pubescent esp. on edges.

The ripe fruit is eaten.

2. MYRTUS, *L.*

Myrtus differs chiefly from *Eugenia* in the horseshoe-shaped embryo, small cotyledons and comparatively large hypocotyl. The petals expand. Carpels 2–3 forming a wholly or almost wholly (septa not quite reaching the apex of the ovary) 2–3-celled ovary, with axile placentation.

1. **M. communis,** *L.* The Common Myrtle.

A shrub with small ovate to lanceolate leaves 1–1·5″ long, very sweet smelling, white flowers about ·75″ diam. solitary axillary on slender peduncles succeeded by ellipsoid berries which finally turn black and are crowned by the 4–5-partite calyx.

Often planted in gardens. Indigenous from the Mediterranean to North-West Himalayas.

3. PIMENTA, *Lindl.* Allspice.

1. **P. officinalis,** *Berg.*

A small bushy evergreen tree 20–30 ft. high with aromatic narrow-oblong leaves with many sec. n. and terminal and axillary 3-chotomous paniculate cymes of rather small white flowers. Sepals and petals 4. Ovary 2-celled with 1–2 pendulous ovules in each cell. Fruit somewhat like a pepper-corn when dry, 2-seeded. Native of the West Indies; sometimes found in the gardens of Indians. The unripe berries dried in the sun yield the Oleum Pimentæ.

4. PSIDIUM, *L.* The Guava.

1. **P. guayava,** *L.* Syn. *P. pyriferum* and *P. pomiferum, Willd.*; Amrud, *H.*; Piyar, *Beng.*

A large shrub or small tree with opposite entire ell.-oblong leaves 4–6″, pubescent beneath and with 15–20 sec. n. Peduncles axillary with 1–3 pretty white flowers 1–1·5″ diam. Ovary usually 4–5-celled with many ovules. The well-known fruit with many very hard seeds. Embryo horseshoe-shaped.

Almost or quite naturalised in the village jungles of Purneah! Native of tropical America. Fl. h.s. Fr. r.s. and c.s.

5. EUCALYPTUS, L'Heritier.

Trees, often gigantic in their native forests, sometimes flowering when quite small, secreting an aromatic gum or resin. Leaves coriaceous, at first often opposite sessile and horizontal (for 3–5 yrs. in *E. globulus*), in older trees they hang obliquely or vertically, are petioled and of a different shape, studded with oil glands and frequently glaucous. Flowers small in heads or umbels rarely solitary axillary. Hypanthium continuous with the pedicel and often usually produced beyond the ovary as a truncate "calyx-tube" without sepals. Petals entirely fused into a calyptra. Stamens numerous. Ovary 3–6-celled with numerous axile ovules. Fruit usually hard and woody dehiscing loculicidally at the top. Seeds numerous.

A very large Australian and Tasmanian genus, the species of which are variously known as Gum-trees, Stringy-barks, Ironbarks etc. *E. amygdalina* attains 480 ft., the highest tree in the world. *E. marginata* is the Jarrah wood largely imported for sleepers. Some species have proved very useful in Italy, Algeria and other places for drying up swamps and lessening mosquitoes and in California, on the other hand, for planting up areas subject to periodic droughts. *E. globulus* and others have succeeded well in the Madras Presidency.

The following species have been tried in this province, viz. *globulus, citriodora, tereticornis, rostrata, crebra,* and a few others. All these and others have been sown at Neterhat but only the first two germinated well. The species best suited to Bihar and Orissa have yet to be ascertained; so far I have only seen *globulus, citriodora* (a deliciously fragrant species) and *tereticornis* which have attained young pole stage. The following descriptions are chiefly compiled from *Mueller's Eucalyptographia.*

I. Anthers mostly broader than long, usually reniform, opening by divergent upwards confluent slits. Umbels generally solitary . . . . 1. *amygdalina.*
II. Anthers not or scarcely longer than broad, usually roundish, slits longitudinal. Umbels mostly paniculate . . . 2. *crebra.*
III. Anthers distinctly longer than broad, ovate to narrow oblong, slits longitudinal almost parallel. Umbels or fls. solitary.
 A. Flowers paniculate. Lid hemispherical . . . . 3. *maculata* (*citriodora*).
 B. Umbels solitary.
  1. Umbels peduncled, several-fld.
   Lid longer than tube with acute beak . . . . 4. *rostrata.*
   Lid longer than tube with sub-terete obtuse beak . 5. *tereticornis.*
  2. Umbels subsessile, 1-fld. Fruit angular and warty . 6. *globulus.*

1. **E. amygdalina,** *Labill.* The Giant Eucalypt. Probably the tallest tree in the world. Stems when growing freely are smooth and almost white. L. rather short-petioled, mostly alternate, narrow- or falcate-lanceolate, usually attenuate into acute oblique base, somewhat shiny. Umbels usually several-fld. short peduncled. Calyx attenuate into a thin pedicel. Ripe fruits small, semi-ovate.

2. **E. crebra,** *F. v. Mueller.* A very sweet-smelling species with dark rugged bark and slender drooping branchlets. L. alt. short-petioled, linear or falcate-lanceolate, rather thin, dull-green, very translucent-dotted. Filaments almost white. Fruit slightly attenuate at base. Germinated at Neterhat.

3. **E. maculata,** *Hooker.* Syn. E. citriodora, *Hook.* in *Mitch. Journ. Trop. Aust.* A tall handsome tree (or, *loc. cit.*, a bush) with smooth somewhat shining whitish or reddish-grey bark mottled with the remains of the older bark. Seedlings rough with red-brown hair. Leaves scarcely shining. Branchlets slightly angular. Leaves shining or not, alt., linear-lanc. often somewhat falcate, sec. n. crowded, rather spreading, prominent with marginal nerve very close to edge, oil-dots not very evident to sight. Fls. in short panicles, sometimes 2–3-nate on the panicle or solitary, pedicels shorter than calyx, calyx-tube short, lid double, inner transparent shining outer hemispheric pointed. Anthers oval-clavate. Fr. globose or sub-clavate, rim narrow, valves 2–4.

Mueller states that *E. citriodora* can only be distinguished from *E. maculata* as a variety differing in the exquisite lemon scent of its leaves and frequently finer-veined. The tree called *E. citriodora* thrives in Ranchi.

4. **E. rostrata,** *Schlecht.* The Red Gum.

A tall tree with smooth ashy grey or white bark and slender branches. L. alt. lanceolate-falcate, sec. n. crowded rather faint, dots scanty or obscure. Umbels lateral or supra-axillary, solitary on slender peduncles 4–14-fld. Calyx-tube semi-globose, lid longer with sub-hemispheric base then sharply beaked. Fruit sub-globose.

The timber is extraordinarily durable bfit less quick-growing than *E. globulus.* The tree will live in swampy land in Australia.

5. E. tereticornis, *Smith.*

Closely allied to last. Leaves with more prominent sec. n. Umbels short-peduncled 4-8-fld. Lid often much elongated in a gradually tapering cone. Top of fruit more protruding.

The seedlings have opposite almost oval leaves. Timber excellent.

6. E. globulus, *Labille.* The Blue Gum.

A tall tree with smooth greyish- or bluish-white bark (except where persistent at base) with robust 4-angular branchlets. L. on old trees alt. (in seedlings opposite sessile cordate or cordate-ovate), lanceolar-falcate, thick, sec. n. oblique not crowded, marginal rather distant from edge, dots inconspicuous. Fls. large axillary solitary rarely 2-3-nate, sessile, short and broad. Calyx glaucous, lid depressed hemispheric, warty-glandular, sharply umbonate, rarely as long as the obverse-pyramidal warty tube. Anths. oblong oval. Fruit rather large, hemispheric or obverse-pyramidal with broad rim and depressed or convex crown.

The young foliage is often very glaucous.

6. MELALEUCA, *L.*

1. M. leucadendron, *L.* Cajeput Oil Tree.

A m.s. usually tall and straight tree with almost white or ashy bark peeling off in large papery flakes, branches pendulous and somewhat willowy with lanceolate, somewhat oblique coriaceous aromatic leaves 2–5″ long, tapering both ends and with 3–12 longitudinal nerves and short petiole. Flowers yellowish-white odourless in erect axillary spikes which are often proliferous. Calyx ·15″ long. Corolla ·3″ diam. Stamens numerous in 5 bundles opposite the petals. Ovary 3-celled with many ovules on peltate placentæ. Capsule loculicidally dehiscent at the apex, subglobose, ·2″ diam.

Frequent in gardens. Native of the Malay Peninsula to Australia. Sometimes confused with *Eucalyptus* and *Acacia.*

7. CALLISTEMON, *R. Br.*

Australian Bottle-brush Trees. Trees or large shrubs, often with willowy foliage and often bright red or crimson small flowers conspicuous by being close together and sessile in a proliferous spike, the small dry fruits remaining for a long time clustered round the branches far below the terminal leaves. Hypanthium more or less globose or urceolate with deciduous dry sepals and caducous petals. Stamens very long usually brightly coloured, free. Ovary 3–4-celled, pubescent on the top which is depressed round the style. Ovules numerous on peltate placentæ. Capsule opening by loculicidal small slits at the top.

1. **C. linearis,** *D.C.*, with numerous bottle-brush-like tufts of brilliant crimson flowers and
2. **C. salignus,** *Sweet*, with small white flowers are both beautiful shrubs or small trees flowering in the hot weather and very common in gardens.

The last has a very hard wood.

FAM. 64. LECYTHIDACEÆ.

Trees (an undershrub in one of our species) with the characters of Myrtaceæ but without oil glands in the leaves and flowers, the leaves alternate and usually clustered towards the ends of the branchlets,

often toothed and usually without an intramarginal nerve or loops. Flowers usually large 4–6-merous, rarely 2–3-merous. Fruit a berry or fibrous or in exotic genera woody and opening by a stoppel.

The flowers of some of this family which are found in Calcutta gardens are exceedingly showy and interesting; such are *Napoleona imperialis* and *Couroupita guianensis*. In the latter tree that part of the hypanthium bearing the androecium grows out sideways and then curves over the top of the flower so that an insect to get at the nectaries has to squeeze itself in between the two staminal (or staminodal in the case of some species) surfaces. To this family also belong the Brazil nut.

Flowers large in short spikes. Fruit baccate, many-seeded . . 1. *Careya*.
Fls. m.s. in pendulous racemes. Frt. angular 1-seeded . . . 2. *Barringtonia*.

1. CAREYA, *Roxb.*

Trees or (*C. herbacea*) an undershrub with large leaves usually toothed and very large spicate or racemose flowers in few-fld. spikes or racemes. Hypanthium slightly produced beyond the ovary with 4 imbricate deciduous sepals. Petals 4 large white or pink. Stamens numerous, the outermost or innermost or both reduced to filiform staminodes, more or less connate at the base. Disc annular intra-staminal. Ovary 4–5-celled. Ovules numerous axile. Style long filiform. Fruit a large globose berry with numerous seeds.

1. **C. arborea,** *Roxb.* Kumb, Kumbi, *H., Beng.*; Asanda, *K.*

A small or m.s. tree with large obovate or obovate-oblong leaves clustered at the ends of the branchlets and large white and pink flowers in dense spikes succeeded by large globose green fruits 2·5–3″ diam. crowned with the calyx-tube.

Throughout the province but chiefly in the moister regions and only found in the valleys of the Central Area. Fl. March or April-May. Fr. July. Deciduous Feb. to the time of flowering, old leaves often red or purple.

Attains 6 ft. girth in Angul where the largest trees are found, but no great height. Bark thick dark brown, rather smooth with exfoliating scales, blaze very thick red and fibrous. Leaves 6–15″ long, glabrous, slightly crenate-denticulate, sec. n. 10–12 not very strong. Flowers with large bracts and bracteoles, sessile or scarcely pedicelled. Sepals ovate obtuse. Petals 1·75″ cream or white. Filaments pink, very numerous. Ovary usually 4-celled.

Wood only used for fuel and agricultural implements. *Brandis* says weight variable but average about 50 lbs. The bark gives a fibre suitable for rough ropes. *Campbell* says that the fruit is eaten but I have not found this. The root is used to kill fish in Gangpur. Except in the grass lands of a damp district like Purneah (where the thick bark makes it tolerably fire resisting) the tree only thrives in shady forests, and though handsome there seldom looks well in a garden.

2. **C. herbacea,** *Roxb.*

An interesting little undershrub like a very dwarf "Kumbi" sending up annually from a woody rootstock reddish shoots with alternate glabrous obovate or oblanceolate serrulate leaves 3–4″ long at time of flowering, ultimately 6–8″ long, and large flowers 2·5″ diam. with a disagreeable odour.

In open grass lands of Champaran! New shoots appear beginning of March and at once flower, but this is partly dependent on the time of firing the grass and they may appear up to May and June, or as early as January.

Leaves rounded at tip, vary attenuate at base into the short rather wider petiole. Flowers often sub-solitary. Bracteoles adnate to base of hypanthium. Sepals broadly-oblong ·5″ long. Petals oblong whitish or purple. Filaments pink below. Fruit (ripe?) 1·5″ topped by the oblong rounded sepals ·4″ long.

2. BARRINGTONIA, *Forst.*

Trees with entire or toothed leaves mostly clustered towards the ends of the branches and large or m.s. flowers in terminal or lateral spikes or racemes with small deciduous bracts. Hypanthium ovoid or turbinate, calyx-tube hardly any, sepals 2–4 rarely 5 imbricate or valvate. Petals 4–5. Stamens connate at the base and tube also adnate to base of petals, anthers short versatile or sub-basal. Disc annular within the stamens. Ovary 2–4-celled with 2–8 ovules in each cell. Fruit pyramidal, ovoid or oblong, sometimes 4-angular, hard and fibrous when ripe, indehiscent, with one seed only. Embryo a thick fleshy hypocotyl with rudimentary cotyledons.

1. **B. acutangula,** *Gaertn.* Hinjal, Hijal, *Beng., Or.*; Ijar, *Th.*; Dundi, *K.*; Ingan, *Kharw.*; Hinjor, *S.*; Hyal or Hyar, *H.* (teste *Buch. Ham.*).

A small or m.s. tree with obovate or oblanceolate denticulate leaves attaining 9″ by 4″ but usually much smaller, narrowed into the ·3–·5″ petiole. Flowers with pale pink very caducous petals but conspicuous from their bright red stamens and from being arranged in long drooping racemes often 2 ft. long. Fruit oblong quadrangular truncate about 1″ long.

Usually on banks of streams but equally common both in the flooded parts and higher lands of Purneah and other swampy parts of Bihar. Singbhum! Manbhum! Gangpur! Athmallik! Puri! Angul! Sambalpur, along the Mahanadi! Rajmahal Hills (no doubt along streams) *Kurz*! Kalahandi! Fl. May. Fr. Sept. Evergreen or nearly so, renewing leaves March–April.

Sometimes attaining 5 ft. girth but always with short trunk. Bark thick dark grey distinctly furrowed on old trees, blaze pink with cheesy cut. Leaves usually 3–5″ with about 10 sec. n. and very reticulate intermediate venation, rather pale beneath. Racemes lax, pedicels ·2–·3″. Hypanthium acutely 4-angled obpyramidal. Sepals ·1″ denticulate. Petals ·2″.

"Wood pale or reddish brown, tough and strong. Wt. about 40–50 lbs. Used for boat-building, wells, carts, rice-pounders and by cabinet-makers." *Brandis.*

FAM. 65. MELASTOMACEÆ.

Herbs or shrubs, rarely small trees, with opposite or whorled entire, rarely serrulate, exstipulate leaves which are usually 3–7-nerved from or from near the base (exc. in Memecyleæ), the nerves extending nearly to the apex. Flowers small or often very showy regular or somewhat irregular in the andrœcium, 2-sexual. Hypanthium usually united by vertical walls to the ovary, sometimes wholly adnate, rarely nearly free, bearing 3–6 sepals or truncate. Petals as many as sepals, contorted in bud. St. as many or more than the petals and inserted with them on the margin of the hypanthium, filaments bent inwards in bud, alternate stamens sometimes different or rudimentary, anthers opening by terminal pores, rarely by slits, connective often appendaged at the base. Ovary 3–6- usually 4–5-celled or (in *Memecylon*) 1-celled, style simple. Ovules very many except in Memecyleæ, axile in the Melastomeæ, free central in Memecyleæ. Fruit baccate or capsular, opening by pores in the top or

sometimes irregularly breaking up. Seeds minute and numerous (exc. *Memecylon*), albumen 0, cotyledons usually short.

I. Sub-family Melastomeæ. Ovary 3-6-celled. Ovules very many on axile radiating placentæ. Seeds very many. Anthers opening by a pore.
  A. Flowers 4–5- rarely 6-7-merous, not spicate.
    Stamens all similar . . . . 1. *Osbeckia.*
    Stamens dimorphous . . . . 2. *Melastoma.*
  B. Flowers 3-merous, in scorpioid spikes . . . . . 3. *Sonerila.*
II. Sub-family Memecyleæ. Ovary 1-celled, ovules about 9 on a free short central placenta. Berry 1-seeded. Anthers opening by pores or short slits. Stamens 8 similar . . . . . 4. *Memecylon.*

1. OSBECKIA, *L.*

Shrubs or herbs with usually 4-angled branches and frequently strigose hispid or with stellately-hairy or setose scales. Leaves opp. or ternate. Fls. terminal capitate or panicled, more rarely solitary, 4–5-merous. Hypanthium with stellate hairs or pectinate scales. Stamens equal or subequal and similar with oblong anthers which may be more or less beaked, connective not produced at the base, slightly swollen or with 2 tubercles. Ovary setose at the apex with very numerous ovules on placentæ radiating from the axis. Capsule opening by 4–5 pores at the top. Seeds curved through half a circle, covered with minute elevated points.

A genus of very pretty herbs or shrubs most of them suitable for a garden.

I. Perianth 4-merous.
  A. Anthers not or scarcely beaked.
    Hairs spreading. Fls. capitate with an involucre of leaves 1. *truncata.*
    Hairs appressed. Fls. 1-3 not capitate . . . . 2. *zeylanica.* Var. *non-rostrata.*
  B. Anthers distinctly beaked.
    Hyp. not necked. Herb under 2 ft. Fls. capitate . . 3. *chinensis.*
    Hyp. long-necked in fruit. Herb 3-5 ft. Fls. panicled . 4. *rostrata.*
II. Perianth 5-merous (rarely 4-merous in *nutans*).
    Small wiry shrub 2-3 ft. Fls. cernuous 1″ diam. . . . 5. *nutans.*
    Shrubby 4-5 ft. Fls. not cernuous 1·5″ diam. . . . 6. *nepalensis.*

1. **O. truncata,** *Don.*

An erect herb slender 4–12″ high with spreading hairs on the 4-angled stem, elliptic or ovate sparsely hairy leaves ·5-1·3″ and very small usually 4-merous pale purple flowers capitate at the ends of the stem or branches. Hypanthium ·1-·15″, 8-ribbed and stellately pilose. Sepals 4 very small ·05″ or less triangular and cuspidate persistent alternating with branched hairs which are as long. Anthers not beaked. Fruit ·15-·2″ with the hairs persistent.

In wet places, not nearly as common as *O. chinensis*. Ranchi! Manbhum, *Camp.*! Gaya, below the ghats (Pathra forest)! Angul, *Chattarjee*! Fl. r.s. Fr. Nov.

Easily recognised in flower by the very small petals not exceeding ·1-·15″. Lower leaves shortly petioled, upper sessile. Inflorescence supported by 3-4 large leaves.

Var. **Kurzii.** Plant scarcely 2″ with very small leaves and flowers and ribs on fruit absent.

Parasnath 4200 ft., *Kurz*.!

2. **O. zeylanica,** *Willd.* Var. non-rostrata.

A very small herb 2-3″ high with the stems strigosely hispid on the angles, small elliptic or oblong leaves ·3-·4″ thinly strigose above

with stout hairs ending in a capillary tip, a continuous row of especially stout adpressed hairs near the margin. Fls. mauve ·5″ diam., not capitate, few, usually about 1–3 at or towards the ends of the branches on pedicels ·05–·07″ long. Hypanthium 8-ribbed setose. Sepals lanceolate ·15″ spreading with long-stalked stellate hairs between. Anthers 8 scarcely beaked. Fruit ovoid setose.

Sands of the Orissa coast, Puri! Chilka Lake (called *O. truncata* in *Herb. Cal.*), *Alcock*! Fl. March.

This differs from the type essentially in the anthers not being beaked. A specimen of *O. zeylanica*, however, collected by *C. E. C. Fischer* in the Anaimalai Hills has only short beaks. The other characters in which it differs such as the very small leaves and few flowers are no doubt the immediate result of its habitat.

3. **O. chinensis,** *L.*

An erect herb 6″ to 2 ft. high with linear linear-lanceolate or oblong leaves 3–5-nerved appressed-hairy both sides and usually 4-merous mauve-coloured flowers about 1″ diam. capitate at the top of the branches. Hypanthium urceolate not ridged, glabrous except for stellate bristles between the sepals, or with a few hairy stipitate scales, often shining in fruit. Anthers with a long beak.

Common in wet places all over the Northern and Central Tract, especially on the mountains! Chota Nagpur, common usually on damp clay soil in grass! Angul, *Chattarjee*! Fls. Aug.–Nov.

Stems 4-angled, sparsely strigosely hairy. L. 1–2·5″ rarely more, margin often obscurely serrulate. Sepals lanceolate glabrous ciliate. Fruit glabrous, ·15–·2″ wide with apical bristles.

Var. **parasnathensis.** Erect, 2 ft., leaves oblong 2″ with sub-cordate base. Fruit often ·25″.

Parasnath!

4. **O. rostrata,** *Don.*

A stout herb 3–5 ft. high, scarcely branched, with opposite or ternate ascending distant leaves 3·5–7″ long with 5–7 principal nerves and numerous distinct obliquely scalariform secondary nerves. Petioles ·2–·4″. Flowers in oblong or pyramidal terminal panicles 4–7″ long at the top of the stem, purple, with petals ·5–·7″ long. Hypanthium glabrous or thinly setose ·3″ long, ovoid oblong with a neck (bottle-shaped), glabrous or setose ·4–·5″ long in fruit.

Fl. Aug.–Sept. Fr. Oct.–Dec.

The following two very distinct varieties occur in the province :—

Var. **pulchella,** *Benth.*

Stems glabrous 4-angled or -winged. L. oblong or oblong-lanceolate acute or sub-acuminate up to 2·5″ broad, glabrous beneath between the nerves, hispid above. Fruits ·5″. Seeds small white with lines of minute dots.

Purneah, in wet ground and swamps!

Var. **sexangulata**, *Haines.*

Stems strigosely hirsute with bulbous-based hairs, 6-angled. L. lanceolate or narrowly-lanceolate up to 1·3″ broad setosely hairy on both surfaces. Petiole densely strigose. Fruit ·3–·4″. Seeds very small orange yellow conchoidly granulate.

Chota Nagpur 3000 ft. in wet places!

The type has 4-angular stems, glabrous or with patent hairs, and corymbose flowers.

5. **O. nutans,** *Wall.*

A pretty little much-branched wiry shrub 2-3 ft. high with narrowly lanceolate 3-nerved leaves 1-1·8″ long glabrous and sometimes golden between the strigose nerves beneath, glabrous and beautifully lineolate above when dry. Flowers 4-5-merous, pale rose-coloured, about 1″ diam. on cernuous pedicels 1-2 together on short axillary and terminal peduncles. Hypanthium glabrous, globose, ·2-·25″ diam. Sep. ·3″ lanceolate, ciliate at base and with pectinate scales between. Free part of ovary and fruit densely strigosely hairy.

Sub-montane tract, along rivers, N. Champaran! Fl. Oct.-Dec. Fr. Nov.-Jan.
Branches strigose. Petiole mostly under ·1″.
C. B. Clarke says (*F. B. I.*, p. 516) that "there is no recorded instance of a normally 5-fid *Osbeckia* producing 4-fid flowers"; this, however, was the case with the first specimens of *O. nutans* collected by me.

6. **O. nepalensis,** *Hook.*

A branched shrub 4-5 ft. somewhat resembling *Melastoma malabathricum* when not in flower but the leaves softly hairy on both surfaces. Flowers in corymbose panicles white (or mauve-purple, *F.B.I.*), 1·5″ diam. Hypanthium with large flat permanent scales pectinate with white bristles and a ring of the same round the top, truncate in fruit. Sepals broad lanceolate ·4″ ciliate. Fruit campanulate (not bottle-shaped) or urceolate, free top short opening by 5 terminal pores densely strigose and with a 5-crenate ciliate crown.

N. Champaran, Bettiah and Ramnagar! N. Purneah, in open grassy jungles! Fl. Oct.-Dec. Fr. Nov.-Dec.
Stems acutely 4-angled strigose. L. lanceolate acuminate subsessile, larger 5·5″ by 1·7″, principal nerves 3 and 1-2 weaker ones each side.

2. MELASTOMA, *L.*

Strigose or villose shrubs with 3-7-nerved leaves and 5- (rarely 6-7-) merous flowers. Hypanthium with simple hairs or scales. Sepals deciduous. Stamens twice as many as the petals, alternate ones longer with purple anthers and connective produced at base terminating in two lobes, the intermediate shorter ones with yellow anthers not produced but with two tubercles in front. Ovary as in *Osbeckia.* Fruit baccate or coriaceous, bursting irregularly. Seeds as in *Osbeckia.*

1. **M. malabathricum,** *L.* Dantgigiri, *Th.*; Gongai, *Or.*; Phutki, *H.*

A beautiful very bushy shrub 4-5 ft. or sometimes 7 ft. high with 4-angled branches densely strigosely-scaly twigs and 3-7-basal-nerved, rough, broadly lanceolate, oblong-lanceolate or elliptic leaves 3-4″ long. Fls. bright mauve-purple 1-1·5″ diam. in clusters of 1-5 at the ends of the twigs with conspicuous yellow stamens. In fruit the hypanthium becomes rather brittle and breaks usually transversely, while the placentæ become very fleshy and purple.

Throughout the area, but especially common in the Northern area north of the Ganges. In the Central and Southern area restricted to the more shady valleys and water courses. Fl. March-May. Fr. Nov.-Dec. Evergreen.
Leaves strigose with stout scabrid hairs beneath and somewhat similar hairs (so adnate their whole length to the epidermis above. Petiole ·3-·5″. The hairs

usually described) on the hypanthium and other parts are rather scales, consisting of very numerous cells and sometimes minutely toothed and with a mid-rib.

The mass of sweetish fleshy placentæ and seeds is eaten and stains the teeth purple.

3. SONERILLA, *Roxb.*

Small herbs, sometimes woody at the base, sometimes stemless. Leaves in a pair sometimes unequal, 3–5-nerved, entire or serrulate. Fls. in racemes or scorpioid spikes with campanulate or a long-funnel-shaped hypanthium and 3 short sepals, 3 petals and 3 stamens (rarely 6), anthers without appendage to connective. Ovary 3-celled, apex glabrous. Fruit a capsule usually 3-gonous and 6-ribbed opening at the top by 3 valves. Seeds very many smooth or minutely tuberculate or punctate, raphe simple or running out into a lateral appendage, sometimes overtopping the seed.

1. **S. tenera,** *Royle.*

A delicate little plant 2–8″ high with often pink stems more or less pubescent and gland-hairy. Leaves membranous ovoid, elliptic or rhomboid 3–5-nerved, larger 1·25″ by ·75″, sometimes obscurely toothed narrowed into the short petiole, sometimes with long sparse hairs above. Racemes or spikes 1–2″, only about one flower opening at a time. Fls. ·3″ long. Sepals broad ovate short cuspidate. Petals pink, clawed, broad-oblong, suddenly acute. Ovary with very thin wall slightly adherent to the hypanthium which is sparsely gland-hairy.

Frequent on moist banks in the hills of Chota Nagpur. Singbhum! Hazaribagh, ascending to top of Parasnath! Neterhat! Fl., Fr. Oct.–Nov.

4. MEMECYLON, *L.*

Shrubs or trees with short-petioled or sessile coriaceous glabrous leaves which are usually penninerved. Flowers in small lateral, rarely terminal, cymes or umbels, often clothing the branches from the axils of fallen leaves. Hypanthium companulate, sepals 4 short or 0. Petals 4 usually blue or white. St. 8 similar with short anthers opening by slits in front, connective with an empty spur or horn behind. Ovary inferior 1-celled enclosed in the hypanthium and with an 8-rayed disc at the top, style filiform, ovules 6–12 on a free central placenta. Fruit baccate but only 1-seeded. Seed large with convolute cotyledons.

1. **M. edule,** *Roxb.* Var. ovata, *Clarke.* Niras, *Or.*

A very beautiful shrub or small tree with ovate acuminate leaves 3 by 1·8″ to 5·5″ by 2·8″ with rounded base and very obscure sec. nervation. Flowers bright blue ·25″ diam. very numerous in clustered compound umbellate cymes not exceeding 1″ long from the old leaf axils. Hypan. pink, shortly tubular-campanulate then spreading and saucer-shaped with 4 shallow rounded sepals, disc beautifully veined with 8 radiating lines united by a marginal one. Pet. 4 blue fugacious broadly ovate. St. blue. Berry ·3–·4″ diam., blue or dark-purple.

Along rocky ravines and on the tops of high rocky hills in Orissa. Baruni and

Kahuri hills and ravines in Southern range, Puri! Ravines in Angul! Rarely also in scrub jungles! Fl. April-June. Fr. June-July. Evergreen.

Attains 2 ft. girth with closely regularly fluted corky bark and hard deep-brown then pale brown blaze, in young trees thin pink and dirty white. L. rarely only 2·5″, acute or obtusely acuminate, with minute black dots beneath, sec. n. 6-9 (fairly distinct in Angul specimens). Petiole ·25-·4″. Cymes (only ·3″ long in some Khurda plants) 1-many from a node with 4-angled peduncles ·25-·4″ long. Fl. buds white very acute.

The berries are eaten.

FAM. 66. LYTHRACEÆ.

Trees, shrubs or herbs, often with 4-angled branches. L. entire, usually opposite, sometimes whorled or alternate, exstipulate, sometimes dotted. Fls. from minute to very large, 2-sexual, regular or somewhat zygomorphous (distinctly in *Woodfordia*) perigynous with the hypanthium growing up around but free from the ovary (exc. *Punica*) though often adherent and accrescent in fruit, generally 3-6-merous. Sepals 3-6, valvate, sometimes with an epicalyx of smaller intermediate sepals (or bracts?). Petals as many as the sepals or 0. St. definite or indefinite perigynous, inserted in the hypanthium or on its throat. Ovary 2-6-celled with long simple style and usually capitate stigma. Ovules very many on large axile, rarely parietal placentæ. Fruit membranous, coriaceous or capsular, sometimes 1-celled by absorption of the septa. Seeds many exalbuminous, sometimes winged. Embryo straight (exc. *Sonneratia* and *Punica*).

In the *Nat. Pflanz. Fam.* Sonneratia (under the name *Blatti*) is placed in a separate family (Blattiaceæ) and *Punica* is placed in another family consisting of the single genus. The last is the most natural arrangement, but as *Punica* is not indigenous in our area it suffices to include it here.

I. Lythraceæ. Flower perigynous. Ovary cells in one whorl.
- A. Trees or shrubs. Flowers often large.
  - 1. Flowers distinctly zygomorphous, hypanthium coloured . . . 1. *Woodfordia.*
  - 2. Flowers regular.
    - *a.* Ovary not adnate at base with hypanthium, 2-6-celled, placentation axile.
      - Flowers 4-merous . . . . 2. *Lawsonia.*
      - Fls. 3- or 6-merous, rarely perianth 7-9-merous. St. ∞ . . . . 3. *Lagerstrœmia.*
    - *b.* Ovary more or less adnate at base to hypanthium, 10- or more-celled . . . . 4. *Sonneratia.*
- B. Herbs with small or minute flowers sometimes apetalous . 5. *Ammannia.*

II. Punicaceæ. Flowers epigynous. Ovary multi-cellular in two whorls . . . . 6. *Punica.*

1. WOODFORDIA, *Salisb.*

A shrub, a single species characterised generally by the cymose tubular flowers which are distinctly zygomorphic with a curved coloured hypanthium somewhat dilated above with oblique mouth, 6 greenish tooth-like sepals, 6 very small scarlet petals and an epicalyx of 6 scales. Stamens 12 inserted below the middle of the hypanthium declinate and of two different lengths in any one flower (fls. trimorphic as in *Lythrum salicaria*, cp. *Darwin's Different Forms of Flowers*). Ovary free oblong 2-celled with filiform style. Fruit dry with thin walls irregularly breaking. Seeds very many, narrowly cuneate-obovate, smooth.

1. **W. fruticosa,** *Kurz.* Syn. W. floribunda, *Salisb.*; Lythrum fruticosum, *L.*; Icha, *K. & S.*; Phuldawai, Dhai-phul, *Kharw.*; Dadki dhatuli, dhauri, *Vern.*

A much-branched beautiful shrub when in flower with sessile or sub-sessile linear-lanceolate acuminate distichous leaves 2·5–4″ long, silvery, finely pubescent and dotted beneath, and brilliant scarlet flowers ·5–·75″ long in fascicled cymes axillary and from the old wood, often completely covering the branches.

A very common shrub except in the plains, chiefly on clay soils in open and second-growth forest, sometimes gregarious. Fls. Jan.–April. Fr. April–May. Nearly leafless end of Feb. and in March when the flower is at its best, leaves often not renewed till end of May in dry localities.

The germination is epigeal but the seedlings most minute with cotyledons the size of a pin's head. I have germinated and grown the plant very successfully by sowing it in heaps of brick rubble which is kept damp.

The flowers yield a dye which is yellow or pink. *Paranjpe* states that it is the dye so familiar during the Holi. Both the flowers and leaves yield a large percentage of tannin. The dried flowers are given with "dhai" in dysentery. On account of the tannin also the powdered flower is sprinkled over unhealthy sores and ulcers. It is a favourite flower among the Kols who wear it in their hair and often mention it in their songs.

2. LAWSONIA, *L.*

A large shrub or small tree with terete often thorny branches, glabrous. Leaves opposite. Flowers rather small in terminal panicled cymes. Hypanthium short cupular. Sepals 4 ovate. Petals 4 obovate, wrinkled. Stamens 4 or 8. Ovary 4-celled or 4-celled at base with many ovules on axile placentæ. Fruit dry coriaceous exserted from the hypanthium, globose, irregularly breaking up and finally 1-celled. Seeds many angular, smooth.

1. **L. inermis,** *L.* Syn. L. alba, *Lamk.*; Mehndi, *H.*; Benjati, *Or.*; Henna.

A small tree 20 ft. high or large shrub with branches often ending in thorns, lanceolate or narrow-rhomboid small leaves ·9–1·5″ very shortly petioled with few rather inconspicuous sec. n. Fls. ·25″ diam. very fragrant, cream-coloured. Fruit red when young, ultimately dry and seated on the hypanthium with the persistent small sepals, depressed globose, ·25–·3″ diam. crowned with the style.

Not uncommon in hedges. Ranchi! Palamau! Gaya! Sambalpur! Fl. Oct.–Nov. Fr. Nov.

Yields the Henna dye.

3. LAGERSTRŒMIA, *L.*

Trees or shrubs with opp. or sub-opp. distichous entire leaves and usually showy flowers in axillary and terminal panicles. Sepals and petals 6–9 on the margin of the cupular or tubular hypanthium; petals very long-clawed, wrinkled, crisped or erose. Stamens very many, inserted near the base of the hypanthium and more or less hypogynous, with long often-curled and barren filaments. Ovary 3–6-celled. Capsule 3–6-valved and -celled, girt by the persistent calyx. Seeds winged at the apex, flat, erect.

Hypanthium strongly ribbed. Fls. large, mauve . . . . . 1. *flos reginæ.*
Hyp. not ribbed. Fls. 1·5–2″ diam., colours various . . . . 2. *indica.*
Hyp. not ribbed. Fls. ·5″ diam., white . . . . 3. *parviflora.*

1. **L. flos-reginæ,** *Retz.* Kwiri, *M.*; Gara Sekre, *Ho.*; Jarul, *Beng.*; Patoli, *Or.*

A large or m.s. tree but often flowering when only 20 ft. high. Leaves elliptic to lanceolate 4–8″ long, glabrous, with rounded base and 6–12 sec. n. Petiole very short. Flowers 2–3″ diam. mauve-purple in long narrowly-pyramidal panicles sometimes a foot long. Hypanthium semi-spherical with alternate strong broader and narrower ribs sometimes slightly produced as teeth beyond its margin (rudimentary epicalyx). Capsule septifragally 5–6-valved, woody, 1–15″ diam. subglobose.

Along the larger rivers and muddy side-nalas in Singbhum! Gangpur! Bonai, Bonaigarh, rare, *Cooper*! Banks of Mahanadi, Angul! Cuttack and Balasore, near the canals, indigenous? Puri (Jaganathprachad Forest), *Haslett*! Often planted and a very handsome tree when covered with its large panicles.

Fl. end of April–June. The capsules remain on the tree till the following flowering season. Evergreen.

Bark nearly smooth, peeling off in flakes, grey. Although an important timber tree in Assam it occurs too sparingly in this province to be of much value.

2. **L. indica,** *L.* Farash, Telinga-china, *H.*; Crepe Plant or Crepe Myrtle.

A very beautiful shrub attaining 15 ft. with elliptic or oblong sub-sessile glabrous leaves acute or sub-obtuse about 1–3″ long and very numerous panicles of white, lilac or rose-coloured flowers 1–1·5″ diam. Hypanthium not ribbed, with triangular sepals and long-clawed petals. Fruit sub-globose ·3″ diam.

Very common in gardens. Fl. May–July. Deciduous in c.s. Native of China.

3. **L. parviflora,** *Roxb.* Asidh, *Th.*; Sekre, *K.*, *S.*; Sidha, *Beng.*; Lendia, Senha, *Gond.*

A tall tree or sometimes a small tree or shrub, with narrowly elliptic or oblong or ovate-lanceolate acute or acuminate distichous leaves 2–3·5″ and delicate white flowers in 3-chotomous panicles with petals ·25″ long. Hypanthium cupular smooth, woody in fruit and embracing the capsule which is ·75–1″ long ellipsoid and polished. 3-, sometimes 4-valved.

Throughout the whole province, attaining its largest size in the sub-Himalayan districts and again in Angul and the better forests of the Orissa States, small in the dryer Chota Nagpur forests and, indeed, frequent in scrub jungles. Fl. April–May. Fr. Dec.–Jan. Decid. Feb.–March and flowers on the new shoots.

Attains 6–8 ft. girth with grey or reddish smooth bark, stripping off in long narrow flakes in old trees, blaze light brown. Young branches often 4-winged. Foliage with a grey or glaucous appearance, the young leaves hoary beneath with a very fine tomentum, old coriaceous, glabrous or shortly pubescent beneath with 6–10 sec. n. Cyme branches and pedicels very slender often 2–5-nate, bracts linear. St. few long and many short.

Var. **majuscula,** *Clarke.* Leaves glabrous larger, sometimes 4–5″ by 2″, fruit larger, sometimes exceeding 1·5 by 1″.

The small tree of Chota Nagpur appears mainly to belong to this variety which seems to be a form of dry uplands.

It is one of the poles most in demand for house-posts and other timber for native buildings. It is also much used for agricultural implements. The fuel, including charcoal, is good. *Gamble* gives the weight as 53 lbs. The gum is said to be edible.

4. SONNERATIA, *L.f.*

Glabrous trees of salt-water marshes with coriaceous leaves and large axillary solitary or terminal ternate flowers. Hypanthium thick cupular or campanulate with 4–8 lanceolate sepals and as many narrow or 0 petals. Stamens many perigynous near mouth of hypanthium. Ovary adnate below to hypanthium or nearly free, 10–15- or 20-celled with very many axile ascending ovules. Fruit 10-15-celled, baccate embraced by the persistent calyx. Seeds very many curved, angular, with convolute cotyledons.

Petals 0. Stigma very large mushroom-shaped . . . . . . 1. *apetala.*
Petals 6. Stigma capitate . . . . 2. *acida.*

1. **S. apetala,** *Ham.* Keora, Kerua, *Or.*

A large tree with pale bark and numerous conical pneumatophores. Leaves oblong or narrow-elliptic, often oblique, 3–4″ long, glaucous both sides and with the sec. n. not visible. Flowers both lateral and terminal 1–1·25″ diam. with the numerous stamens, sepals broadly lanceolate 4 or sometimes 5. Petals 0. The flower is at once recognisable by the long style with its remarkable mushroom-shaped stigma. Fruit ·5–·75″, broader than long.

Common in the tidal forests of the Mahanadi delta! Fl. Feb.–May.

Often 4 ft. girth with grey-green bark on young stems, blaze with chlorophyll then white and brown, bark of old trees dark-grey and rough below, blaze hard dark crimson. Pneumatophores with exfoliating bark. Leaves attenuate at base into a ·2–·25″ petiole.

The wood is not much used but is said to be used in the Sunderbans for planking and for fuel. The fruit boiled till it is soft is cut in half and is used as a fish bait.

Gamble says that the bark is black! He gives the weight of the wood as about 40 lbs.

2. **S. acida,** *L.* Ora, *Beng.*

A small tree about 20–25 ft. with broadly obovate or sub-orbicular more rarely oblong leaves 2·5–3·5″ long, pale beneath, sec. n. fine but distinct, about 10, base narrowed into the very short petiole. Fls. over 2″ diam. with large calyx 1·3″ long (including the hypanthium). Petals linear, 6. Capsule globose much depressed often 2″ broad.

Tidal forests of the Mahanadi delta! Fl. June-July. Fr. Aug.

Bark white and blaze white but rather darker on the wood. Pneumatophores corky. Inflorescence articulate.

The above is somewhat doubtful. The tree was not in flower and the flower is described from a Bombay specimen. As the species occurs in the Gangetic delta there is, however, considerable probability of its occurring in Orissa.

5. AMMANNIA, *L.*

Small annual herbs growing in wet places, with branches frequently 4-angular. L. opposite or upper alternate, rarely whorled, entire. Flowers small or minute axillary solitary and sessile or in spikes or small axillary cymes, bracteoles 2 sometimes minute. Hypanthium tubular or campanulate with 4–5 rarely 3 small sepals and sometimes small intermediate folds or teeth (epicalyx). Petals 5–1 or 0, inserted between the sepals, a small annular disc rarely present inside the petals. St. 3–8 rarely 2, inserted usually near the middle of the hypanthium. Ovary free, 3–5-celled or by absorption of the septa 1-celled. Ovules very many axile. Capsule thin-walled 2–4-valved or more or less irregularly dehiscent or circumsciss. Seeds many

minute, usually rounded on the back and concave or flat with a low rim on the face, rarely angled.

The genus is sometimes divided into three: *Rotala*, *Ammannia* and *Nesæa*. In the first two the central axis with placentæ is not continuous with the style and in *Nesæa* it is. In *Rotala* the capsule opens by valves and in the last two it is said to rupture irregularly or circumscissilely, but in some species of *Ammannia* the valves are nearly regular.

I. Flowers solitary in the axils of leaves or bracts. Capsule valvular.
  A. Flowers distinctly spicate, spikes peduncled terminal. Fls. pink.
    L. small orbicular. Hyp. campanulate. Pet. twice sep. . 1. *rotundifolia.*
    L. ell. or ovate. Hyp. tubular. Pet. smaller . . . 2. *tenuis.*
  B. Fls. axillary or spikes axillary, not peduncled.
    1. Hypanthium tubular. Ovary and capsule oblong.
      Stems ascending. L. obovate, margined ·5–·7″ . . . 3. *indica.*
      Stems prostrate. L. linear ·2–·3″. Sepals 5 . . . 4. *dentelloides.*
    2. Hypanthium campanulate. Ovary usually 3-lobed. Capsule as broad as long.
      a. Procumbent cæspitose herb. L. linear under ·3″ Sep. 4 . . . . 5. *pygmæa.*
      b. Ascending or erect herbs. L. oblong or lanceolate over ·3″.
        Fls. mostly 4-merous. Epicalyx 0, petals yellow . 6. *densiflora.*
        Fls. 5-merous. Epicalyx conspicuous. Petals pink or 0 7. *pentandra.*
II. Flowers cymose or clustered axillary.
  A. Clusters or cymes sub-sessile.
    L. tapering at base . . . . 8. *baccifera.*
    L. rounded or cordate at base . . . . . . 9. *salicifolia.*
  B. Cymes distinctly peduncled.
    Capsule much exceeding hypanthium ·1″ long . . . 10. *senegalensis.*
    Capsule hardly exceeding hypanthium, ·05″ long . . 11. *multiflora.*

1. **A. rotundifolia,** *Ham.* Sim-sindur, *S.*

A very pretty little herb forming carpets of magenta or pink when in full flower with very numerous erect branches 3–6″ high from a creeping stem. Leaves sessile orbicular or broadly elliptic rounded each end ·2–·5″ long. Fls. in the axils of small foliaceous bracts in dense terminal often 3-nate spikes. Hypanthium campanulate. Petals conspicuous twice as long as the sepals. Capsule 4-valved ellipsoid. Seeds ellipsoid peltate.

Common in wet places especially by the marshy sides of streams, gregarious. In all districts, ascending to the tops of the mountains! Fl., Fr. Jan.–May.

The flowers are dimorphic in respect to the length of stamens and style (*teste C. B. Clarke*).

2. **A. tenuis,** *Clarke.* Syn. Ameletia tenuis, *R. Wight.*

A little plant resembling *A. rotundifolia* but far more delicate and less showy. Leaves ·1–·25″ elliptic or ovate, often acute. Spikes on very slender peduncles with oblong or lanceolate bracts, hypanthium narrowly funnel-shaped or tubular with acute lanceolate sepals and with large bracteoles at the base about three-fourths its length. Petals lanceolate-obovate only slightly exceeding the sepals. Capsule 2-valved.

Behar, *Kurz*! *J.D.H.*! Fl., Fr. Oct.–Dec.

3. **A. indica,** *D.C.* Syn. A. peploides, *Spr.*, Rotala indica, *Koehne.*

An erect succulent herb 5–12″ with decumbent often rooting base and quadrangular stems and branches. Leaves often close, elliptic-

obovate or elliptic with attenuate base, sessile, ·3–·7″, distinctly margined, tip rounded or obtuse, sec. n. 4–6 rather prominent beneath. Fls. very pale pink narrowly campanulate, solitary axillary on very short spiciform axillary branches with reduced narrow-oblong leaves (or bracts), base of bract also often pinkish. Bracteoles linear setaceous ·1″ long, *i.e.* about as long as the flower. Sepals lanceolate acuminate 4 exceeding the very minute petals, or petals 0. Ovary oblong. Capsule ellipsoid or oblong about as long as hypanthium, 2-valved. Seeds "narrow oblong sub-falcate, pink," *Clarke*.

Rice fields and wet places, common. Singbhum! Ranchi! Parasnath, *Prain*! Bettiah, *Hieronymus*! Angul, *Chattarjee*! Probably in all districts. Fl., Fr. Oct.–Dec. or up to Feb. in moister situations.

4. **A. dentelloides,** *Kurz*.

A small procumbent weed with stems 2–4″ long and opposite linear leaves ·2–·3″ long. Fls. axillary. Hypanthium tubular-campanulate 5-ribbed with 5 triangular sepals minutely thinly puberulous. Petals minute. Capsule ellipsoid 2-valved.

Found in the Sikkim Tarai and probably Purneah. A note in the *Calcutta Herbarium* also says Parasnath, *Kurz*, but I can find no Parasnath specimens.

N.B.—Koehne, in *Das Pflanzenreich*, states that this is a Scropulariacea: cp. *Microcarpæa muscosa*.

5. **A. pygmæa,** *Kurz*.

A very small and slender but cæspitose weed 1–3″ high or decumbent branches up to 5″, with linear leaves ·1–·25″ long and most minute flowers in their axils. Bracteoles shorter than the flower filiform or as long as the ·02″-long campanulate hypanthium. Sepals 4 rarely 5. Petals 0. Stamens 2 rarely 3–4. Capsule broadly ellipsoid before dehiscence then about as broad as long, 2-valved or 3-valved. Seeds concave white, brown or black.

Frequent on damp ground and sometimes inside the forest. Ranchi! Singbhum! Parasnath, *Clarke*! Manbhum, *Ball*! Santal P., *Kurz*!

It sometimes forms green mats in the damp beds of nalas. Fl., Fr. Nov.–Jan.

6. **A. densiflora,** *Roth*. Syn. Rotala densiflora, *Koehne*.

General habit of *A. peploides*, 6–16″ high. Leaves oblong or oblong-lanceolate sub-amplexicaul with cordate base decurrent as four wings on the stems, branches, and spikes, cauline ·5–1″, upper smaller with more acute base and passing into bracts, tip rounded, scarcely tapering, sec. n. distinct. Fls. on the short spiciform axillary branches but these sometimes elongate as in *A. pentandra*, bracts ·1–·2″, scarcely tapering, pink at the base. Fls. solitary ·05–·06″ long, pink, with yellow tubular-campanulate hypanthium and minute bracteoles only one-third as long; sepals 4, very rarely 5 (3–6 *Koehne*), pink, very broadly ovate then suddenly acute, petals 0–4 (3–6 *Koehne*), but usually 1, yellow. Stamens inserted below middle of tube. Ovary 3-lobed microscopically trabeculate, style short but half as long as ovary or longer. Capsule nearly as broad as long.

Wet ground, Purneah! Fl., Fr. Dec.

Perhaps only a variety of the next, the length of the style being a bad character.

7. **A. pentandra,** *Roxb.* Syn. Rotala leptopetala, *Koehne,* and R. densiflora, *Koehne* ?

An erect weed 4-15″ high, in robust specimens pyramidal with very numerous spreading branches. Lower leaves oblong or lanceolate acute from a broad sessile sometimes cordate or truncate (sub-cuneate or contracted, *Koehne*) base, ·5-1·3″ long, smaller upwards and becoming bractiform with a sessile flower in every axil, sec. n. obscure, bases decurrent as angles or wings but branches less alate than in the last species. Floriferous branches often elongate (and when at the same time the main cauline leaves drop the plant looks different and is apparently the *Rotala illecebroides, Koehne*). Bracteoles acicular as long as or nearly as long as the flower. Fls. pink ·1″ long with broadly campanulate hypanthium. Buds depressed acutely 5-angled, sepals usually 5 broadly triangular, often finely acuminate, intermediate teeth (epicalyx) distinct spreading acicular. Petals usually present pink elliptic-oblong above the claw, obtuse or retuse, twice the sepals. Disc often prominent annular and 5 stamens from inside the disc when present. Ovary prominently 3-lobed, sub-globose style scarcely longer than stigma, capsule globose, 3-valved.

Wet ground, especially on clay soils, very common throughout the province. Often turning red when the ground dries up. Fl., Fr. July-Jan.

8. **A. baccifera,** *L.* Syn. A. vesicatoria, *Roxb.*

Erect, stout for the genus, 6″-2 ft. high with square stems and opposite leaves below, often alternate above, lower narrowly elliptic-lanceolate tapering both ends, attaining ·3″ by ·6″ but often only ·3″ on depauperated plants, successively smaller upwards. Flowers minute green pedicelled, in few-fld or dense axillary usually umbelliform cymes under ·2″ long, turning red in fruit. Buds 4- or 8-angled often like two equal pyramids placed base to base with the four corners somewhat subulate-mucronate (intermediate folds or epicalyx). Hypanth. broadly campanulate or obconic with 4, rarely 5, broadly triangular sepals, petals 0 (or small, *Clarke*), stamens 4 with very short filaments. Capsule depressed-globose exceeding the calyx and red in fruit, circumsciss, 1-celled.

In rice fields and wet places throughout the province. Fl., Fr. r.s. and c.s. A plant from a marsh in Porahat was 3 ft. high, with very few-fld. cymes, but it was young and old cymes become more and more congested until, as *Clarke* says, they appear as knots on the branches. *Roxburgh* says that the leaves are exceedingly acrid and are largely employed as a vesicant.

9. **A. salicifolia,** *Monti,* is scarcely more than a variety of *A. baccifera* distinguished by the leaves not tapering at the base but rounded or sub-cordate. They sometimes attain 3″ in length.

Behar, *J.D.H.*

10. **A. senegalensis,** *Lamk.*

An erect weed 6″-2 ft. high with sharply 4-angled branches. Larger leaves attain 1-2″, linear-oblong or linear-lanceolate from a broad sub-hastate base. Fls. in axillary peduncled cymes which attain ·5-·7″ in length but are shorter than the subtending leaves. Hyp. tubular-campanulate with green ribs, sepals 4 broadly tri-

angular and intermediate ribs sometimes excurrent as teeth (epicalyx). St. 6–8. Fruit globose. ·1″ diam.

Purneah, *Kurz*! Upper Gangetic Plain (and therefore probably extending throughout the Northern area), *Duthie*! Fl., Fr. r.s. and c.s.

11. **A. multiflora,** *Roxb.*

An erect weed 6″–2 ft. high with numerous erecto-patent sharply 4-angled branches. Leaves linear or linear-oblong from a very broad sub-hastate or auricled base, larger sometimes 1–1·5″. Flowers in compound peduncled cymes usually longer than the subtending leaves. Hyp. campanulate or tubular campanulate with 8 green ribs; longer than the 4 broadly triangular mucronulate sepals. Petals very minute red or 0. St. 4, 6, or 8 with slender filaments exceeding the sepals. Fruit globose minute ·05″ diam.

Very common in wet places in all districts. Fl., Fr. r.s. and c.s. This is perhaps scarcely more than a finely branched variety of the last with smaller fruits but its appearance is different in the numereus slender cymes overtopping their leaves and becoming racemed.

6. PUNICA, *L.* Pomegranate.

1. **P. granatum,** *L.* Anar, *H.*; Dalim, *Beng.*

A large shrub or small tree with terete, or when young, 4-angled often thorny branches and opposite, sub-opp. or clustered oblong or obovate obtuse entire leaves with a distinct or obscure intramarginal nerve. Flowers large 1–5-nate terminating the shoots, with a thick fleshy, at first spherical, finally flask-shaped hypanthium produced considerably beyond the ovary and bearing above (in the neck) a thickened disc. Sepals 5–7 persistent. Petals 5–7 inserted between the sepals, obovate, imbricate in bud and crumpled. Stamens very many covering the whole of the disc, anthers versatile introrse. Ovary inferior adnate wholly or for the most part to the hypanthium, many-celled, the cells in 1–3 concentric more or less superposed whorls, style long, stigma capitate. Ovules very numerous anatropous, in some cells axile, in others parietal. Fruit a globose berry with coriaceous epicarp and crowned by the calyx, many-celled and -seeded. Seeds angular, cotyledons convolute.

Very commonly cultivated in gardens. In this province chiefly for its scarlet or orange-red flowers which are about 2″ diam.

Fl. April–May. Fr. July–Sept.

The bark and rind of the fruit are used for tanning. The edible pulp is formed from the outer layers of the testa of the seed.

FAM. 67. ONAGRACEÆ.

Herbs, rarely undershrubs, sometimes aquatic. Leaves opposite or upper alternate, more rarely all alternate, simple (submersed leaves in *Trapa* are pinnatipartite), exstipulate. Flowers regular and typically 4-merous or sometimes sub-regular, often large or m.s. or showy, axillary, spiked or racemed. Hypanthium entirely enclosing the ovary (exc. in *Trapa*) with 2–5, usually 4 valvate sepals. Petals alternate with the sepals, rarely 0. Stamens as many or twice as many as the sepals, epigynous, on the mouth of the hypanthium. Ovary adnate to the hypanthium 1–6-, usually 4-celled, style simple

with capitate or 2–4-lobed stigma. Ovules 1–many in each cell axile, pendulous or half-ascending. Fruit usually capsular, sometimes indehiscent, 1–many-seeded. Seeds with little or no albumen.

I. Hypanthium more or less produced above the inferior ovary. Ovules and seeds many in each cell. Terrestrial or aquatic.
  Fls. 4–6-merous, diplostemonous . . . . 1. *Jussiæa.*
  Fls. 3–5-merous, isostemonous . . . . 2. *Ludwigia.*
II. Hypanthium cupular calyciform only enclosing the lower part of the ovary, with no free tube above. Ovule 1 in each cell. Floating aquatic herb . . . . 3. *Trapa.*

N.B.—*Trapa* sometimes forms the type of a separate family, the Hydrocaryaceæ.

The Samydaceæ are in the *Genera Plantarum* placed after the Onagraceæ. The family has already been described with the Flacourtiaceæ.

1. JUSSIÆA, *L.* (Jussieua, *Auct. plur.*)*

Herbs or undershrubs growing in wet places, sometimes floating with modified air-roots. Leaves alternate mostly entire. Fls. yellow or white, solitary axillary or sub-racemose. Hypanthium elongate but very slightly produced above the ovary with 4–6 acute persistent sepals. Petals white or yellow. Stamens twice the number of sepals, one whorl sometimes smaller, epigynous. Ovary 4–5-celled with very short style and 4–5-lobed stigma. Ovules many axile 1–several-seriate in each cell. Capsule linear 4–5-celled, 8–10-ribbed, opening from above septicidally, or the valves separating from the ribs or breaking irregularly between the ribs. Seeds many, sometimes dimorphous and enclosed in a corky fissile endocarp.

A. Creeping or floating. Leaves obovate . . . . . 1. *repens.*
B. Erect. Leaves lanceolate acute.
  Usually pubescent. Sep. broad. Seeds all similar . . . 2. *suffruticosa.*
  Glabrous. Sepals narrow. Lower seeds different from the upper and 1-seriate . . . . 3. *fissendocarpa.*

1. **J. repens**, *L.* Kesara-dam, *Beng.*

Creeping on the margins of tanks and with long stems floating out on the water by means of white air-roots ·5–1·5″ long. Leaves obovate or oblanceolate ·5–3″ long narrowed into a long petiole. Flowers pretty, white, 1–1·5″ diam. with the veins at the base of the petals yellowish. Petals 5–6 obovate, long- or short-peduncled. Capsule ·5–1·5″ rather woody. Seeds smooth reticulate 1-seriate each enclosed in a corky segment of the endocarp ("with a white corky testa" *Clarke*).

Common on tanks. Chota Nagpur! Santal Parganas! Purneah! Angul, *Lace*! Fl., Fr. c.s.

2. **J. suffruticosa**, *L.* Dak'ichak', *S.*

An erect herb, scarcely an undershrub, suffruticose, 2–4 ft. high usually (always?) hairy and with decurrent raised lines. Leaves

* Since this sheet was sent to press *Ridley* has written a paper on "The Indo-Malayan Species of *Jussiæa*" in the *Journal of Botany*, September, 1921. He splits up *J. suffruticosa, nobis*, into *J. erecta, L.*, and *J. villosa, Lamk.*, and states that *J. fissendocarpa* is the real *J. suffruticosa* (though he does not give all the characters). I find it difficult to determine from this paper whether one Angul specimen (col- lected by *Chattarjee* is *Ridley's J. erecta* var. *exaltata* or *J. villosa, Lamk.*

linear or lanceolate, rarely ovate-lanceolate, pubescent or hairy, subsessile or very shortly petioled. Hypanthium subsessile or tapering into a very short pedicel, pubescent, sepals ovate or broadly elliptic and acuminate, ·2–·3″. Petals yellow ·25–·5″ long. Capsule 1–2″ tapering at base, pubescent (or finally glabrous, *teste Clarke*), thin, and breaking up between the ribs. Seeds rounded, brown or reddish, finally grooved.

Common in wet places, sides of tanks, etc., throughout the province! Fl., Fr. c.s. *Raimann* suggests that the seeds are each formed of two coalescent ovules of which one is barren.

3. **J. fissendocarpa,** *Haines* (*Journ. As. Soc. Beng.*, xv, 1919, No. 7).

A very tough much-branched undershrub 3–4 ft. high, stems glabrous with raised decurrent lines from the leaf-bases or sub-alate. Leaves lanceolate or linear lanceolate subsessile acute. Flowers sessile from all the upper axils. Sepals lanceolate ·08–·1″. Petals shorter. Stamens with 4 smaller or absent. Hypanthium 4-ribbed. Capsule slender minutely pubescent ·6–·85″ long terete 4-celled. Seeds in upper part of capsule minute ellipsoid sub-compressed, pale brown, ·07 mm. with a prominent raphe (or white and half the size), several-seriate, in lower part of capsule 1-seriate, each enclosed in a 2-valved corky prismatic portion of the endocarp and larger.

Watery places, Purneah! Fl. Nov.–Dec. Fr. Dec.–Jan.

Upper leaves about 1″ (the lower fallen in my specimens), not tapering to a slender base as in *Ludwigia parviflora* and *L. prostrata*, nearly glabrous. I have seen very few flowers and the size of the petals may vary.

2. LUDWIGIA, *L.*

Habit of *Jussieua* but perianth 3–5-merous, petals small inserted below the margin of the epigynous disc and stamens as many only. Ovules in two or more vertical rows in each cell. Capsule opening by terminal pores or breaking up irregularly along the sides. Seeds obovoid smooth.

Capsule inflated, seeds many-seriate in each cell . . . . . 1. *parviflora*.
Capsule very slender. Seeds in one row in each cell . . . . 2. *prostrata*.

1. **L. parviflora,** *Roxb.*

A herb 8–18″ high usually erect, glabrous, with lanceolate, linear-lanc. or linear-oblanc. leaves 1·5–3″ long always tapering at the base into a short petiole. Fls. very shortly pedicelled small yellow usually 4-merous. Capsule very short oblong or linear-oblong ·3–·4″ long, glabrous, seeds many-seriate not separately distinguishable through the capsule walls.

Gaya, near Grand Trunk Road! Chota Nagpur, *Prain*! Manbhum, common in ricefields, *Clarke*, *Milne*! *Kurz* says common in wet places in Western Bengal; his specimens are, however, small and diffuse.

Fl. Oct.–Nov. Fr. Nov.–Dec.

2. **L. prostrata,** *Roxb.*

Somewhat like the preceding but more diffuse prostrate or ascending with the lower branches longer than the stem spreading flat on the ground and rooting, generally reddish. Leaves thin glabrous lanceolate or ell.-lanceolate with very fine sec. n., narrowed

at base into a slender petiole. Sep. ·07″ narrow-lanceolate acute. Petals lanceolate longer than the calyx (*Roxb.*) yellow. Capsules much more slender than in last, ·8″, linear, often more or less curved, glabrous, obtusely 4-angled. Seeds minute pink 1-seriate, distinguishable through the capsule wall.

There are no specimens actually collected inside our area but it has been collected both sides, in the Gangetic plain and the Sikkim tarai. It will therefore almost certainly be found in the Northern Area.

"Roots often cellular and float-formed," *Keenan.*

3. TRAPA, *L.*

Aquatic herbs with the floating leaves rosulate, rhomboid, their petiole with a spongy dilatation, submersed leaves* in opposite pairs and cut into capillary segments. Flowers axillary solitary 4-merous with cupular hypanthium not produced above the ovary, sepals persistent, two or all spinescent in fruit. Sepals, petals and stamens in alternate whorls inserted on the margin of a perigynous disc. Ovary adnate below to the hypanthium, conical above, 2-celled with 1 ovule only in each cell pendulous from the inner angle. Fruit consisting of the lignified hypanthium, ovary and calyx together forming a 1-celled 2–4-horned indehiscent nut with a short often spinous beak through which the radicle issues. Cotyledons very unequal.

1. **T. bispinosa,** *Roxb.* Singhara, Pani-phal, *H.*; The Water Chestnut.

Floating leaves ·8–2·5″ diam., broader than long, denticulate, dentate, serrate or incised, with entire base, beneath red and densely pubescent or villous. Petiole 4–7″ long, the inflated portion about 1″ long, hairy or woolly. Fruit somewhat urn-shaped ·9″ long with the two horns forming the handles of the urn; the second pair of horns are usually wanting.

In tanks throughout the province! Fl. Aug. Fr. Nov.–Dec.

According to the *F.B.I.* the typical plant has leaves 2·5–3″ wide, slightly crenate and very villous beneath, while var. *incisa* has leaves only about ·75″, inciso-serrate and much less villous. The common form in our area has the leaves about 2″ diam. and coarsely toothed. Fls. white, ·75″ diam., not much raised above the surface of the water.

The kernel of the fruit is eaten.

FAM. 68. TURNERACEÆ.

A tropical American and African family of which we are only concerned with the following genus:—

1. TURNERA, *L.*

Shrubs or herbs with alternate simple leaves usually 2-glandular at the base with small or 0 stipules. Flowers regular 2-sexual axillary solitary, rarely fascicled or in racemes, yellow; peduncle sometimes adnate to the petiole, bracteoles 2 or 0. Hypanthium short usually swollen at the insertion of the stamens. Sepals 5. Petals 5, hypogynous, inserted at the base of the hypanthium. Stamens

* These organs are probably floating adventitious roots as described in *Nat. Pflanz. Fam.* They arise below the axils of fallen leaves.

5, more or less perigynous and often connate at base, anthers oblong with longitudinal dehiscence. Ovary free 1-celled with 3 parietal placentæ and 3 styles simple or with flabellately divided stigmas. Ovules numerous anatropous, 2-seriate on the placentæ. Fruit a 3-valved capsule bearing the seeds in the middle of the valves (as in Samydaceæ or Flacourtiaceæ to which the family is closely allied). Seeds oblong curved with a membranous aril, fleshy albumen and terete embryo.

1. **T. ulmifolia,** *L.* Basanti, *Vern.*

Herb or undershrub with densely hairy shoots broad- or narrow-lanceolate or elliptic-lanceolate coarsely serrate leaves 3–4″ long with 2 large glands at the end of the ·5–1″-long petiole. Fls. yellow 1·5–2″ diam. with the peduncle adnate to the petiole and bearing a pair of leaves below the flower (bracts?). Hypanthium funnel-shaped hairy with lanceolate sepals ·3–·4″ long. Capsule sub-globose oblong ·3″ hairy and minutely tubercled, sometimes only 2-valved, with elliptic-oblong brown rugose seeds.

Bettiah, *Rastler*! Roadsides, Orissa! Fl., Fr. c.s. Introduced from America.

FAM. 69. PASSIFLORACEÆ.

Herbs or shrubs climbing by means of tendrils, very seldom twining, with alternate stipulate simple and palmi-nerved or usually palmately-lobed, rarely penni-nerved leaves frequently with glands on the undersurface or petiole. Flowers axillary cymose rarely solitary regular 1–2-sexual and sometimes dimorphous. Hypanthium usually well-developed, mostly tubular or campanulate with 3–5 sepals. Petals usually present and free, sometimes connate, alternating with the sepals imbricate in bud, marcescent. A 1–many seriate "*corona*" of filamentous or other formed scales usually clothes the intra-staminal zone of the hypanthium. Stamens 5 usually on a gonophore, sometimes inserted inside a semi-perigynous disc, anthers oblong, introrse. Ovary usually on the gonophore but sometimes sub-sessile, 1-celled with 3 rarely 4 parietal placentæ and 1–3 styles with more or less capitate stigmas. Ovules numerous on the placentæ 2–many-seriate anatropous. Fruit a berry or capsule. Seeds usually many with a fleshy aril and albumen, cotyledons foliaceous.

1. PASSIFLORA, *L.* Passion-flower.

Flowers 2-sexual with well-developed hypanthium. Sepals often coloured within. Petals free. Stamens on a long gonophore with the ovary. Coronal filaments very numerous. Ovary with 3 placentæ and more or less distinct styles. Fruit baccate.

A large American genus with few representatives elsewhere. Some species are common in gardens.

1. **P. fœtida,** *L.*

A slender fœtid-smelling climber with palmately-3-lobed leaves 1·5–2·5″ long, ciliate and denticulate with gland-tipped setaceous

hairs, similar hairs also beneath and simple hairs above, stipules laciniate with gland-tipped segments. Flowers 1″, greenish, mostly solitary axillary, with an involucre of finely pinnatifid bracteoles with capillary glandular segments. Fruit like a small green gooseberry.

Widely distributed, in most districts! Fl., Fr. r.s. and c.s.

FAM. 70. CARICACEÆ.

Small trees, often with an unbranched crown of long petioled alternate palmi-lobed leaves and with milky juice. Flowers monœcious or usually diœcious, the females shortly cymose, solitary, or fascicled axillary, the males smaller in axillary panicles, 5-merous. Calyx short. Corolla of male gamopetalous, of female much larger polypetalous. Stamens in the male 10 in two whorls in the corolla-tube. Female with staminodes. Ovary 1- or 5-celled with short style and 3-5 palmately-branched lobes. Hermaphrodite flowers occasionally occur in three forms, either the stamens are only 5 hypogynous in an otherwise nearly normal female flower, or the stamens are 10 perigynous inserted high up in a tube adnate to the corolla, or the stamens are 10 epigynous closely adnate to the ovary with their bases connected by a ridge. Ovules very numerous parietal. Fruit a large 1-celled or 5-celled berry. Seeds many with an outer sappy and an inner hard testa, albuminous.

1. CARICA, *L.*

1. **C. papaya,** *L.* Papaya, Papita, *Vern.*; The Papaw.

A well-known small tree with very large palmately lobed leaves, the lobes again variously lobed. Sepals and petals in alternating whorls. Flowers greenish-white or white, females large subsolitary or in very short cymes, males panicled. The different 2-sexual forms referred to above all occur in this species in India, always (where I have seen them) on a male inflorescence. Fruit 1-celled.

Fl., Fr. end of r.s. and beginning of the c.s. The digestive ferment Papain is extracted from the milky sap.

FAM. 71. CUCURBITACEÆ.

Herbaceous, more rarely shrubby, climbing by means of tendrils. Leaves alternate simple palmately lobed or pedately divided, rarely pinnately lobed, venation palmate or pedate. Flowers small to very large, solitary axillary clustered cymose or racemose, monœcious or diœcious. Calyx and corolla inserted on a variously shaped often elongate hypanthium which is constricted above the ovary.* Corolla poly- or gamo-petalous. Stamens inserted at various levels on the

* In referring to the shape of the hypanthium in the generic and specific diagnosis the male hypanthium and the female part of the hypanthium above the ovary is alluded to. As the wall of the hypanthium forms also the ovary wall the shape of the ovary is sufficiently explicit for the lower part.

hypanthium, normally 5 with extrorse anthers each with one anther-cell, but usually connate in pairs so that only one remains free (in which case there appear to be two stamens with 2-celled anthers and one with 1-celled anther and are *shortly described* as "three stamens"), anthers often connate and their cells straight or variously curved or twisted. Ovary usually 1-celled, the three parietal placentæ often however meeting and filling up the ovarian cavity, or ultimately 3-celled. Ovules anatropous usually numerous. Style stout with 3–5 stigmas. Fruit a berry, entirely succulent or finally with a hard rind (when it is called a pepo), rarely entirely dry. Seeds with a hard testa, exalbuminous with straight embryo.

The morphology of the tendril has been investigated by several authors. It is apparently a shoot or partly a shoot and partly petiolar and foliar. The axil of the leaf often contains a peculiar stipule-like bract, described as a solitary stipule by *Roxburgh* in the case of some species. This member has scarcely been noticed in any other work I have seen. It would also appear to be the first leaf of a suppressed axillary shoot. It is very noticeable in species of *Luffa*, *Cucurbita*, etc.

In all the genera examined by me with the compound microscope, viz. *Trichosanthes*, *Luffa*, *Momordica*, *Bryonia*, *Cucurbita* and *Cephalandra*, the ovary is initially 1-celled with parietal placentæ. In some cases the apparent septa is an exceedingly small-celled tissue or mucilage formed subsequently to the meeting of the enlarged placentæ with which the ovarian cavity becomes filled and the tissue of which is plentifully supplied with spiral vessels. In *Luffa* the septa are the ingrown placentæ. Germination is epigeal, the cotyledons sometimes attaining very large dimensions.

The following species all belong to the tribe Cucumerineæ in which the ovules are mostly horizontal, leaves not compound, female flowers usually solitary.

- I. Petals free or corolla deeply 5-partite.
  - A. Flowers white (or greenish in *Melothria*, sp.).
    - 1. Anther-cells conduplicate or sigmoid.
      - *a.* Fls. large, solitary. Hypanthium funnel-shaped* . . . 1. *Lagenaria.*
      - *b.* Fls. large or m.s. Hyp. tubular elongate.
        - Petals fimbriate. Tendrils 2–5-fid. . . . . 2. *Trichosanthes.*
        - Petals entire or toothed. Tendrils 1–2-fid† . . . 3. *Gymnopetalum*
    - 2. Anther-cells straight or curved.
      - Flowers small. Hypanthium campanulate . . . . 4. *Melothria.*
  - B. Flowers yellow.
    - 1. Fls. small, solitary or clustered. Anthers 3 free.
      - Anther-cells straight, connective muticous . . . 5. *Mukia.*
      - Anther-cells curved or sigmoid . . . . . 6. *Bryanopsis.*
    - 2. Fls. m.s., solitary or clustered. Anthers cohering, cells horse-shoe shaped or conduplicate.
      - *a.* Peduncles not bracteate.
        - Connective crested. Tendrils simple . . . 7. *Cucumis.*
        - Connective muticous. Tendrils 1–3-fid† . . . 8. *Citrullus.*
      - *b.* Peduncles (or those of male) slender with a large median or apical bract. Tendrils simple . . 9. *Momordica.*
    - 3. Flowers large, solitary. Stamens inserted near mouth of hypanthium, anther-cells sigmoid . . . . 10. *Benincasa.*
    - 4. Fls. large, male-peduncles often paired, one with racemed fls. (exc. *Luffa*, sp.). Stamens often 5.
      - Stamens 3–5. Anther-cells sigmoid . . . . 11. *Luffa.*
      - Stamens 5. Anther-cells straight . . . . . 12. *Thladiantha.*
- II. Corolla distinctly gamopetalous with tube exceeding the lobes.
  - Flowers yellow, very large. Tendrils 2–4-fid . . . . 13. *Cucurbita.*
  - Flowers white, m.s. Tendrils simple . . . . . 14. *Cephalandra.*

---

* In the female the shape of the hypanthium above the ovary is alluded to.

† 1–2-fid means *simple* to 2-fid.

1. LAGENARIA, *Seringe.*

Large herbaceous climbers, pubescent, with 2-fid tendrils, ovate or orbicular cordate and dentate leaves and long petiole with 2 glands at the apex. Flowers large white solitary monœcious or diœcious, M. long- F. short-peduncled. M. hypanthium funnel-shaped subcampanulate with 5 narrow sepals, petals 5 free obovate, stamens (apparently) 3 with connate included anthers and conduplicate anther-cells. Pistillode 0. F. perianth as in male, ovary oblong, with short style and 3 2-fid stigmas. Fruit large indehiscent polymorphous. Seeds compressed smooth with a marginal groove.

1. **L. vulgaris,** *Ser.* Syn. Cucurbita lagenaria, *L.*; Lauki, Kadu, *H.*; Lau, Ladu, *Beng.*; Loewa, *Uran*; Suku, *K.*; Bottle-gourd.

A coarse glandular and softly hairy usually monœcious plant with hairy leaves 7–8″ diam., 2-glandular at the base, and large solitary white flowers 3–4″ diam. Male peduncle 5–6″, hyp. ·5–·75″, sepals ·3–·4″, petals often 2″ by 1″ ovate with excurrent mid-rib. Fem. sepals ·25″ linear, hyp. tube above the ovary very short, hypanthium and young fruit villous or hairy.

Cultivated in all districts. Fl. July–Jan. Fr. c.s.
The unripe fruit contains a thick white pulp which in the cultivated plant is sweet and edible. The ripe fruit is variously-shaped with a very hard shell; a common form is dumb-bell-shaped used for bottles (tumba, *K.*), musical instruments, etc.

2. TRICHOSANTHES, *L.*

Herbaceous or suffruticose with 2–5-fid tendrils and white flowers, males in long racemes (exc. *dioica*) with a solitary female or male at the base from the same axil, or females separate. Hypanthium elongate tubular or wider above and dilated above the ovary. Corolla rotate with nearly free fimbriate petals. Filaments 3, anthers connate (free in *dioica*). Fruit ellipsoid to elongate or globose, smooth. Seeds many compressed, usually margined.

Perennial. Bracts large sheathing . . . . 1. *palmata.*
Annual or perennial. Bracts very small or 0.
  Longer male peduncle with a raceme of flowers . . . . 2. *cucumerina.*
  Both male peduncles with single flowers St. free . . . 3. *dioica.*

1. **T. palmata,** *Roxb.* Kaubutki, *K.*; Makal, *H.*, *Beng.*; Jar Mahwrar, *Kharw.*; Ma Kirla, *Or.*

Trailing on bushes or climbing on high trees with a suffruticose stem and long pendent branches, 2–5-fid tendrils, and rather large simple or lobed cordate and denticulate leaves attaining 6″ by 5″. Flowers white 2·5–3″ diam., bracts on the raceme broadly obovate foliaceous and over ·5″ long with large deep green circular glands and sharply dentate. Fruit bright scarlet globose or usually ellipsoid 2–2·5″ by 2″ on axillary short stout peduncles.

Widely distributed but nowhere very common. Purneah, common! S.P.! Ranchi, Palamau and Singbhum in Chota Nagpur, in valleys and on the plateaux! Angul! Fl. Aug.–Sept. Fr. Nov.–Dec., rarely to Jan. Perennial.
Large green glands sometimes near base of leaf. Always some leaves lobed on large plants, lobes mostly 5 broadly or narrowly lanceolate with the nerve slightly excurrent, in one variety incised and sub-spinulose, upper surface smooth and bright green with small pits when fresh but very scabrous with small round discs

(cystoliths) when dry, lower surface paler with cystoliths on the nerves when dry, primary nerves 3–5 (or 7, lowest forked near base). Petiole 1–2″. Some specimens have the nerves slightly scabrid-hairy beneath, others glabrous but with more marked cystoliths, but the former are in flower and the latter in fruit and it may be a matter of age. Flowers diœcious (or sometimes monœcious?). Male peduncles usually paired, the racemed one 3–4″. Calyx-tube 1·5–2·5″ long. Rind of fruit ·25″ thick when fresh. Seeds embedded in dark-green pulp, oblong, flattened, slightly narrowed at base, ·4–·5″ long.

The fruit and root boiled with mustard oil is used for headache. The root is said to be poison and applied for snake-bite.

2. **T. cucumerina,** *L.*, inc. T. anguina, *L.* (see variety). Bir Kaita, *K.*; Ban potol, *Beng.*

A slender rather succulent climber with long-petioled deeply cordate 5–7-angular or -lobed and dentate leaves 3–4″ diam. rarely 5″. White flowers ·75–1·2″ diam. with fimbriate petals and spindle-shaped rostrate fruits 1–3″ long at first green with white stripes, ultimately red.

Frequent in Chota Nagpur! Behar, *Hope*! Probably in all districts.

Fl. Aug.–Dec. Fr. Sept.–Jan. It is always described as annual, but this is not always the case. Not only is the rootstock sometimes stout but I have found the remains of a previous crop of fruit on a new flowering plant.

Stems often angled and ·25″ diam. L. mostly sub-orbicular, smooth to touch, basal sinus very marked, either rectangular or almost enclosed by the basal lobes, margin denticulate from the mucronate nerve endings. Primary nerves closely shortly pubescent or somewhat scabrous beneath, above puberulous, petiole 1–1·5″. Tendrils 3-fid. Monœcious. Male and female from the same axil. Male raceme 2·5–3″ or ·5–8″ long. Fem. solitary shortly stalked. Hypanthium ·25–·75″.

Var. **anguina.** Syn. T. anguina, *L.*; Kaita, *K.*; Chachinda, *H.*; The Snake Gourd.

This is the cultivated form. Leaves 4–6″ or up to 11″ diam., sometimes very deeply lobed with narrow sinuses except the basal one which is very broad. Fls. 1·5–2″. Fruit very long, attaining 2 ft. and often spiral, green with white stripes when young.

Very commonly cultivated. There are all gradations between this and the wild form. *Chachinda* is usually served up in the shape of French beans, long narrow strips of very light vivid green but no flavour.

3. **T. dioica,** *Roxb.* Potol, *Beng.*; Palwal, *H.*

A climber with rather slender angled stems hispid and with soft hairs, ovate cordate leaves 2–4″ with a deep sinus, margins denticulate and occasionally lobulate, petiole ·5–1·5″ hispid and hairy or almost woolly. Fls. all axillary, M. often paired, one short- the other long-peduncled, hyp. slender 1·2–1·5″ long, villous or woolly. F. short-peduncled 1·5″, a glandular bract at base of peduncle. Sep. oblong-lanc. ·2″. Fruit 2–3·5″ or (in cultivation) 4″, oblong, orange. Seeds ·3–·5″, little-compressed with a slightly corrugate margin.

Rare in a wild state. Darbhanga, *Prain's Collector*! Fl., Fr. r.s.

L. scabrous with cystoliths when dry, basal lobes rarely somewhat hastate. Tendrils usually forked. Peduncle of long-peduncled male slender, often 2″ long. Pet. ·5″ with long fringes. Stamens 3 distinct.

The unripe fruit cooked forms a commonly eaten vegetable. *Roxburgh* says that it is reckoned extremely wholesome. The tender tops are also used as a pot-herb and are regarded as tonic and vermifuge. The tender shoots and dried fruits are very bitter and aperient and given in decoction to assist digestion. Seeds anthelmintic (*Nadkarni*).

3. GYMNOPETALUM, *Arn.*

Leaves as in *Trichosanthes*. Tendrils simple. Fls. white or yellow, as in *Trichosanthes* but F. also sometimes racemed like the male, hypanthium sometimes curved, sepals linear or subulate, petals entire or toothed but not fimbriate. Fruit often ribbed when young. Seeds compressed marginate in a blackish-green pulp.

1. **G. cochinchinense,** *Kurz.* Kaubutkila, *K.*

A pretty climber with bright-green foliage and white flowers 2″ diam. M. solitary and racemed from the same axil. F. solitary or occasionally also racemed. Corolla-lobes oblong toothed or entire. Fr. 2″ by 1·25″ bright orange-scarlet, ovoid-oblong, with 10 strong ribs when young.

Ranchi and Singbhum, on the ghats and plateaux. Fl. Aug.-Oct. Fr. Sept.-Nov.

Stems sparsely pubescent or hispid. L. lower deeply cordate orbicular, 5-7-lobed and denticulate 2-4″, scabrous above, hispidulous beneath, basal lobes rounded and sinus wide, other lobes acute or acuminate. Raceme 5-9″ with foliaceous bracts ·5″, obovate-cuneate, palmatisect. Hypanthium curved pubescent 1″, sepals ·25″. Anthers connate. Fem. hyp. ·5-·6″ above produced as a calyx-tube ·5-·6″ above the pubescent ovary, which is 10-ribbed. Seeds brown, somewhat compressed, ·3″ by ·12″.

4. MELOTHRIA, *L.* (inc. Zehneria).

Usually slender herbs with simple tendrils and entire to deeply-lobed leaves. Fls. small white greenish or yellowish-white, monœcious or diœcious, pedicelled corymbose or racemose or clustered on the rhachis of a raceme, very rarely in axillary clusters, female solitary, fascicled or umbelled. Hypanthium tubular-campanulate or broadly campanulate with minute sepals. Corolla deeply 5-partite. Stamens 3 inserted about or below the middle of the hypanthium, anthers free or slightly cohering with anther-cells straight, flexuose or sigmoid, connective muticose or papillose at the top or produced beyond the cells, staminodes sometimes present in female. Hypanthium much constricted above the ovary which is oblong or fusiform, more rarely globose, with 3 placentæ and numerous ovules. Disc present annular at base of the short style. Stigmas 3, rarely 2. Pistillode present in male. Fruit baccate with usually many ovoid or oblong-rounded or compressed, smooth tubercular or pitted seeds, sometimes obscurely margined.

The *F.B.I.* keeps *Zehneria* separate from *Melothria*. *Cogniaux* unites these two genera as well as *Mukia*. The last differs in its pronounced yellow flowers always clustered axillary short-pedicelled or sub-sessile and small, round, never fusiform fruit.

L. polymorphous. M. fls. corymbose. Petals triangular . . 1. *heterophylla.*
L. 3-lobed. M. fls. clustered on the angles of racemes. Petals ovate 2. *zehnerioides.*

1. **M. heterophylla,** *Cogn.* Syn. Zehneria umbellata, *Thw.*; Ban Kundri, *H., Beng.*; Chengor, *K.*; At', *S.*; Karakia, Matka, Makirla, *Or.*; Tura, *Gond.*

A prostrate or climbing plant with angled smooth stems from a tuberous root (a chain of fusiform tubers in old plants), polymorphous

leaves usually 5-nerved and pale beneath, always cordate, hastate, or sagittate at the base, denticulate, rarely exceeding 6″ in length and always with a very short sometimes pubescent petiole ·25–·75″ long; glabrous or hispid above. Hypanthium greenish, petals small triangular white. Male flowers articulate ·2″ on slender pedicels ·17″ long in peduncled corymbose racemes under 1·5″ long, and usually with a solitary short-peduncled female from the same axil; connective papillose on the top, pistillode 3-lobed, pedicels with a fusiform bract from near the middle. Ovary narrow. Fruit ellipsoid 1–1·6″ long scarlet with red pulp and 12–20 smooth ellipsoid slightly compressed white seeds, sometimes with a slightly corrugate margin. Fruiting peduncle ·3–·6″ stout.

Throughout the province inside the forests and especially in rocky ravines (probably on account of the pigs being unable to get at the tubers). Fl. April–Oct. Fr. May–Jan. Dies down at the end of the c.s. and puts out new shoots in the hot season.

Every part of the plant is eaten, including the leaves and ripe fruits. The following forms occur:

I. Leaves not, or only slightly, lobed with rounded lobes, ovate cordate.
  a. L. small 1–2·5″ with minute pits above when green (as in most of the forms) showing as small raised discs (cystoliths) when dry. Puri!
  b. L. 2·5–5·5″ glaucous. Puri! Angul! Mayurbhanj, *Burkill*! Chota Nagpur!
  c. Leaves up to 7″ with 5-nerved base but only 2–3 sec. n. It is called Ma-kirla in Angul from confusion with *Trichosanthes palmata*, from which it may be distinguished in leaf by its weak habit. L. only denticulate, neither rugose nor with impressed nerves above nor hispid on the nerves beneath, also by its short petiole.
  d. Like (*c*) but more lobed and sinuate, called "Matka" in Angul, never dentate or serrate as in *Trichosanthes*.

II. Leaves hastately or sagittately lobed.
  a. Lobes sub-equal. Burdwan, *Clarke*! Mayurbhanj!
  b. Mid-lobe very much larger than the side lobes.
    i. Leaves under 3″. Puri!
    ii. Leaves up to 6″ long or more, cystoliths less evident. Purneah! Chota Nagpur!

III. Leaves deeply 3–5-palmatifid with all lobes narrow and usually small. Puri!

NOTE.—*Clarke* (*F.B.I.*, ii, p. 625) says that the seeds are sometimes only 4–6 but he includes *Bryonia amplexicaulis*, *Lamk*. He also notes that the bracts on the pedicels are sometimes absent. They appear to me always to occur on some of the pedicels and in young stages of the inflorescence. They are very curious structures, being often inflated! The female flower is often solitary in the axils of leafy bracts of lateral branchlets with a similar inflated bract in the same axil.

2. **M. zehneroides,** *Haines. Journ. Asiatic Soc.*, xv, No. 7, 1919.

A slender climber with striate sparsely hispid stems, 3 (–5) -lobed leaves 2·5–3″ long scabrid on the margins and nerves and with very scabrid petiole ·3–·5″. Fls. small white clustered at the angles of short racemes, ♂ and ♀ mixed, campanulate with linear-subulate sepals. Anthers all 2-celled with nearly straight cells and connective neither swollen nor produced. Fruit ·3–·4″ sub-globose or somewhat ellipsoid on slender peduncles with flat elliptic-obovate white seeds ·13″ long.

Purneah! Fl., Fr. Dec. [But all the mature male flowers fungus-infested in my specimens and buds only available.]

Leaves with lanceolate or oblong or linear oblong lobes, the basal sometimes with a subsidiary lobe very like forms of *Zehneria umbellata* but easily distinguished by the hispid nerves and a few long hairs at the top of the petiole insertion. Racemes zigzag 1–2·5″ long, pedicels ·2–·3″ scabrid. Fem. fl. ·3″, hypanthium white broadly campanulate, sepals small linear, corolla rotate with broadly ovate acute papillose petals.

5. MUKIA, *Arn.*

Scabrous herbs with simple tendrils and 3–7-angular not deeply-lobed cordate leaves, often sub-sessile. Fls. small yellow, M. and F. clustered in the same axil; males very shortly peduncled and F. subsessile. Hyp. campanulate, sepals very small subulate, corolla 5-partite. St. 3 inserted low down, anthers free with straight cells. Ovary ovoid with thick style 2–3-lobed. Placentæ 2–3, ovules not very many. Berry small globose. Seeds ovoid compressed strongly margined, faces rough or smooth.

1. **M. maderaspatana,** *Kurz.* Syn. M. scabrella, *Arn.*; Cucumis maderaspatanus, *L.*; Melothria maderaspatana, *Cogn.*; Bilari, *H.*

A very scabrous small climber with firm 3–7-lobed and toothed very rough deeply cordate leaves attaining 4″ by 3·5″, usually much smaller. Petiole of upper leaves sometimes 0, of lower sometimes attaining 2″. Flowers ·12–·17″ diam. Berries scarlet with firm epicarp ·3–·4″, often hairy.

Common, climbing over bushes in low jungle and open places. Fl., Fr. Sept.-Dec. Very pretty when in fruit with its clusters of scarlet berries.

6. BRYONOPSIS, *Arn.*

Climbing with 2-fid tendrils. Leaves palmately or sub-pedately 3-7-lobed. Flowers small yellowish, M. and F. clustered in the same axils. Hyp. (*i. e.* above the ovary in F.) widely campanulate with minute sepals. Corolla 5-partite. Stamens 3 inserted low down, anthers free with curved or sigmoid cells, connective muticous. Pistillode 0. Ovary ovoid with slender 3-fid style, disc 0. Placentæ 3. Berry globose. Seeds not very many, oblong or ovoid compressed with a corrugate vertical band (in our species).

1. **B. laciniosa,** *L.* Syn. Bryonopsis laciniosa, *Naud.*; Kahubotke, *S.*; Pachguria, *Kharw.*; Mala, *Beng.*

A climbing fœtid herb with cordate usually deeply 2–7-lobed or -partite leaves 2–4″. Petiole 1–1·5″. Flowers small yellowish, males with slender ·5–1″ pedicels, females shorter. Fruit smooth globose ·5–·6″ diam. green or when quite ripe red, with white stripes. Seeds in a blue-green pulp, pear-shaped.

Common in hedges. Purneah! Throughout Chota Nagpur! Angul! Fl., Fr. April-Dec.

Stems nearly smooth. Leaves sometimes only 3-lobed and less than half-way down but usually 5-lobed beyond the middle and with two subsidiary basal pedate lobes, orbicular-ovate, three central lobes usually lanceolate and narrowed at their bases, slightly scabrid above, almost smooth beneath, margin minutely denticulate, cystolithic dots above when dry but not very conspicuous. Flowers sometimes in much abbreviated racemes. Petals ·2″ light-yellow.

The fruit is eaten readily by horses and cattle.

7. CUCUMIS, *L.*

Hispid or scabrid herbs with simple tendrils and monœcious flowers. Males fascicled or sub-solitary, females solitary, axillary short-peduncled. Hypanthium short. Corolla deeply divided. Stamens 3, anther-cells conduplicate or only flexuose. Connective produced

into a crest above the anther. Ovary sometimes apparently 3-septate, style short, stigmas 3, obtuse. Fruit fleshy. Seeds oblong compressed mostly smooth.

A. Leaves scabrid. Fruit quite smooth.
  L. palmately 3-5-lobed beyond the middle. Fr. oval . . . . 1. *trigonus.*
  L. scarcely lobed. Fr. roundish . . . . 2. *melo.*
B. Leaves membranous hairy. Fr. hispid or muricate . . . . 3. *sativus.*

1. **C. trigonus,** *Roxb.* Bing Dimbu, *K.*

A procumbent and trailing plant, scarcely ever climbing, with scabrous stems and petioles and small deeply palmately 3–5-lobed harsh leaves 1–2·5″ diam., scabrous on both sides and with the lobes dilated at the tips or again sub-lobed. Fls. yellow ·5″ diam. Fruit usually ellipsoid, rarely ovoid-globose, 1·25–1·5″ diam. striped green and white or green and paler green, quite smooth, finally yellowish.

Very common on open dry ground. Fl., Fr. Aug.-Oct.
The root is said to be perennial and according to *Naudin* it is by this character alone that the species can properly be distinguished from the next. It is very probably the wild form or one of the wild forms of the cultivated Melon. Petiole ·5–1·5″. Male fls. sometimes solitary. Hypanthium densely hairy or villous, ·25″, with very small sepals, corolla ·5″ diam., hispid-hairy without. Pedicels ·3″.

2. **C. melo,** *L.* Kakri (the vegetable), *H.*; Karbuz (the fruit); Melon.

The above names refer to the cultivated plant. The wild form is called Bing Dimbu by the Kols. This is a procumbent annual plant sometimes with the stem rather thickened towards the base, the whole plant scabrid and hispid but the hispid hairs are often deciduous above the base, especially on the leaf surfaces between the nerves, thus leaving it nearly scabrous. Leaves orbicular or ovate with shallow rounded or sub-angular lobes or sub-entire, denticulate with mucronate nerve-endings, texture thinner than in the last species, 1·5–2·5″ diam., basal sinus often very shallow, petiole 1·5–3″, tendrils often long which it uses chiefly for climbing among grass only. Male flowers usually 5–6 axillary with peduncles about ·25″. Hypanthium ·25″ campanulate villous, sepals distant linear-subulate very small. Corolla ·5–1·25″ diam. divided beyond the middle, lobes obtuse pubescent. Fem. solitary, much as in the male. Fruit spherical usually striped as in the last.

Common in waste ground in Chota Nagpur and probably in other districts! Fl., Fr. r.s.
The cultivated Melon only differs by the larger size of all its parts and perhaps by the somewhat softer indumentum. *Prain* says it has both soft and harsh hairs. The fruit of the wild plant ultimately turns yellow, and is conspicuous lying on the ground attached to the plant long after the death of the vegetative parts, which are distinctly annual.

3. **C. sativus,** *L.* Khira, *H.*; Kaknai, *Or.*; Cucumber.

A hispidly hairy climber with membranous deeply cordate angled or shallowly 3–5-lobed leaves about 4·5″ diam., the larger up to 6″ by 5·5″, both sides hairy with softish hairs but the upper with thickened bases and the ribs beneath scabrid or hispid, margin denticulate, terminal lobe sometimes lanceolate and basal lobes sometimes sub-hastate. Petiole 2–4″. Flowers yellow ·7–1″ diam. Males clustered,

hyp. tubular or campanulate with long white hairs ·25–·3″, sepals linear spreading ·15–·2″, fil. very short, anthers cohering with connective crested or clavate above the cells. Female solitary, hypanthium ·15″ more urceolate with oblanceolate sepals ·2″, thickly covered with very bulbous-based hairs or soft spines ending in a deciduous hair so that the fruit is covered with harsh hairs or soft spines and finally more or less muricate, cylindric.

Apparently wild in several places in Chota Nagpur in open and scrubby jungles! and in the Porahat Forests (*e.g.* between Nakti and Tebu)! Fl. r.s. Fr. up to Oct.

The cultivated plant is the well-known Cucumber and the above-described forms are probably feral. *De Candolle* surmised that the wild plant is indigenous in India in the region of Afghanistan.

The flattened and elliptic seeds, like those of *C. melo*, yield a sweet edible oil which is nutritive and diuretic. The pulp of the fruit is also diuretic and beneficial in eczema (*Nadkarni*).

8. CITRULLUS, *Neck.*

Usually prostrate and trailing hispid or scabrous herbs with simple or 2–3-fid tendrils and palmately or pinnatifidly lobed leaves often with sub-pinnatifid segments. Flowers monœcious, solitary, rarely geminate, yellow, not very large with short campanulate hypanthium. Corolla rotate, deeply lobed. Stamens 3, anthers scarcely cohering, connective not produced, cells conduplicate or sigmoid. Ovary with 3 placentæ, short style and 3 reniform stigmas. Fruit at first very fleshy, globose or ellipsoid, smooth, indehiscent. Seeds very many oblong compressed smooth.

Leaves 2–4·5″, pale, with the close scabrous cystoliths . . . 1. *colocynthis.*
Leaves 3–8″, thin, sparsely scabrid. Cultivated . . . . . 2. *vulgaris.*

1. **C. colocynthis,** *Schrad.* Indrayan, *H.*; Colocynth or Bitter Apple.

Rather a pretty prostrate very scabrous grey coloured herb with usually simple tendrils ovate or lanceolate or lanceolate-oblong leaves pinnatifidly lobed, the lowest lobes palmatifid opposite, segments again pinnatifid, lobed or lobulate, closely covered with small round discs when dry and nerves hispid. Fls. ·5–·7″ diam. Fr. globose 1–3″ diam. smooth variegated green and white on a hispid and hairy peduncle. Seeds ·2–·25″ by ·15″.

Said to be generally cultivated, but I have not seen it so in our province. My specimens were collected in the Central Provinces and were apparently wild. Fl. Nov. Fr. Jan.

The fruit is bitter, acrid and cathartic and finds a place in the *British Pharmacopœia.* It is poisonous in large doses.

2. **C. vulgaris,** *Schrad.* Syn. Cucurbita citrullus, *L.* (also in *F.I.*); Tarboj, K.; Tarbuz, *H.*; The Water Melon.

Prostrate with pubescent or hairy or nearly glabrous stems and 2–3-fid tendrils. Leaves 3–5-partite with the segments pinnatifid or lobed, sometimes linear, denticulate or margin nearly smooth, usually about 6″ by 5″, dotted beneath and somewhat scabrid with hispid or hairy nerves. Fls. solitary or paired on long peduncles 1–2″. Hypanthium short campanulate with linear sepals ·25″ long. Corolla salver-shaped 1″ diam. lobed nearly to base, petals 3–5-nerved,

somewhat puberulous. Stamens distinct, anthers sigmoid. The second flower in the axil is often abortive. Fruit 4–10″ diam.

Largely cultivated, especially on the sides of rivers. Annual. Native of Tropical Africa, and *De Candolle* relates that both sweet and bitter fruits are found in the wild state. Fl., Fr. h.s.

The axil of the leaf often contains a peculiar obovate stipule-like bract ·75″ long, 3-nerved and foliaceous, which is probably the leaf of a suppressed axillary shoot. It would be described by *Roxburgh* (but he gives no detailed description of this species) as a stipule and corresponds to his "solitary axillary cordate stipule" in *Luffa pentandra*.

9. MOMORDICA, *L.*

Tendrils simple. L. undivided or palmatisect. Fls. monœcious or diœcious, solitary peduncle often with a large bract. Hyp. campanulate. Corolla nearly polypetalous. Filaments 3, anthers with horse-shoe-shaped or conduplicate cells. Style long, stigmas 3. Fruit indehiscent or sometimes 3-valved, muricate echinate or smooth. Seeds obovate or oval sometimes rectangular often corrugate on the margin and sometimes on the faces.

In a species outside our area the M. peduncles are 2–5-fld. and the stamens are two only.

Fls. monœcious. L. very deeply 5–7-lobed. Fr. tubercled . . . 1. *charantia*.
Fls. diœcious. L. entire or slightly lobed. Fr. echinate with soft spines . . . . 2. *dioica*.

1. **M. charantia,** *L.*, inc. M. muricata (*F.I.*).; Karela, *H.*; Kirla, *K.*; Karena, *Or.*; Karala, uchchhe, *Beng.*

A softly-hairy rather slender climber with pedately 5–7-fid or -sect leaves 1–4·5″ diam., the segments again lobulate or sinuate and denticulate, the teeth usually ending in a fine point. Fls. yellow ·5–·6″ diam., males on filiform peduncles often 3·5″ long with one orbicular foliaceous bract near the middle, female peduncle nearly as long, bracteate near the base. Petals sometimes distinct to base, obovate, spreading. Fruit ovoid or fusiform, tapering both ends, ribbed and covered with tubercles, 2–3″ long, yellow when ripe, beaked. Seeds compressed with corrugate margins.

Very common in hedges and widely cultivated. Often found wild in waste places. Fl. Aug.–Jan. Fr. Aug.–Feb.

The fruit is bitter, but wholesome and eaten as a vegetable. It is said to be tonic and stomachic and useful in gout and rheumatism. It is also anthelmintic (*Nadkarni*).

2. **M. dioica,** *Roxb.* Ochen, *K.*; Kaksa, *H.*; Ban-Karela, *Beng.*; Kanchan-arak', *S.* (the fruit "Karla").

A slender nearly glabrous climber with fœtid smell, angular stem, deeply cordate simple or 3-lobed often sinuately denticulate ovate leaves 2–4·5″ and solitary axillary yellow diœcious flowers with petals ·7–1″ long, M. on slender peduncles 2–6″ easily recognised by the persistent spathaceous deeply concave orbicular bracts wrapping round the buds and enclosing base of the flowers. F. peduncles usually somewhat shorter or as long as the male with a small bract somewhere near the middle, ovary densely hirsute-fimbriate, the fimbriæ in fruit bearing soft fleshy spines which are lanceolate to ovate when dried.

Common in hedges throughout the province and apparently wild. Fl. Aug.–Sept. Fr. Sept.–Oct.

Root perennial, tuberous. L. punctate beneath and dots sub-translucent when fresh (appearing as white dots above when dry), basal auricles sometimes very large and meeting round the sinus. M. fl. calyx campanulate ·4″ long with oblong-lanceolate or linear sepals as long as tube. F. fl. ovary ·3″, sepals ·2–·3″ linear or linear-lanceolate. Fruit 1–3″, ellipsoid acute or ovoid. Seeds ·4–·45″, more or less compressed, closely inverted with an aril-like integument, ellipsoid, dark grey, nearly smooth or with corrugate margins.

The leaves are eaten as a sag and the fruit is also eaten when young.

NOTE.—The short-peduncled female plant has been repeatedly mixed up with *Luffa graveolens* and *L. echinata*, but the peduncle is rarely as short as in those species; the young fruit too is ovoid and beaked and the fimbriæ, though sometimes slightly hairy, are never hispid; the remains of the sepals form another useful character (cp. with those species).

10. BENINCASA, *Savi.*

A single species.

1. **B. cerifera,** *Savi.* Syn. Cucurbita Pepo (*F.I.*); Kumra, *H.*, *Beng.*; Rakhsa, *K.*; The White Gourd Melon.

A rather large climber, softly hairy all over and with 2-fid tendrils. Resembles a *Cucurbita* in its large solitary axillary yellow flowers and foliaceous sepals, but the corolla is only *very slightly gamopetalous.* Flowers monœcious, the male with a longer peduncle than the female, hypanthium (with calyx) campanulate, sepals 5 foliaceous, pinnatifid or serrate. M. with 3 stamens with free exsert anthers, cells sigmoid. Fem. with densely hairy ovary, 3 flexuose stigmas and 3 parietal placentæ. Fruit rounded-oblong, at first hairy, finally glabrous, 12–18″ long with a whitish bloom. Seeds white, oblong, compressed, with tumid margins.

Fairly generally cultivated. Fl., Fr. c.s.

Leaves reniform-orbicular, 3–6″ long and broad, deeply cordate and sometimes with small angular lobes, margin toothed; petioles hairy, 1–3″, tapering above. Flowers about 2″ diam.

The young fruit is eaten cooked and is also made into sweetmeats. It is said to be alterative, antimalarial, cooling and laxative, and is said to be a good antidote for many kinds of vegetable poisons.

11. LUFFA, *Cav.*

Tendrils 3–5-fid. Fls. monœcious. Males in long racemes (except in *graveolens*) with a solitary male or solitary female from the same node, or female in a different axil. Bracts usually glandular. Male hypanthium obconic or campanulate. Corolla rotate from the top of the hypanthium or lining it to the base. Filaments 3–5 inserted at base of corolla tube, anthers free or in three groups, more or less exsert, cells sigmoid or sinuous on the margins of the often lamelliform connective. Fem. hyp. scarcely produced above the ovary which is narrow and ultimately 3- rarely 4-celled. Fruit ultimately dry with a very coriaceous or sub-woody epicarp and fibrous mesocarp, opening by a stopple.

The placentation in this genus becomes apparently axile or nearly so from the ingrowing of the placentæ.

I. Male flowers racemed, sometimes also a solitary one from same axil.
  A. Stamens always 3. Fruit covered with bristles . . . 1. *echinata.*
  B. Stamens 3-5. Fruit not bristly.
    St. usually 3. Fruit sharply 10-angled . . . . . . 2. *acutangula.*
    Stamens usually 5. Fruit smooth . . . . 3. *ægyptiaca.*
II. Male flowers clustered. St. 5. Fr. softly bristly . . . 4. *graveolens.*

1. **L. echinata,** *Roxb.*

A procumbent or scandent herb with 5-angled slender stems, distinctly 3–5-lobed ovate or broadly ovate deeply cordate and denticulate leaves 1–2·5″ long and broad, somewhat hispid or hairy both sides and on the nerves beneath strigosely or hispidly hairy, cystolithic discs small when dry. Tendrils 2-branched. Fls. white ·5–1″ diam. Males in few flowered racemes 2–8″ long with slender pedicels. Fem. solitary, often in same axil as males, with peduncle ·3–·8″ long densely echinate with soft hispid spines. Capsule 1–1·3″ long ellipsoid with bluntly conical tip densely spiny with rigid prickles.

Purneah, often near rivers ! Fl. Sept.-Nov. Fr. Oct.-Jan.

There is considerable confusion in Herbaria in respect of this species, and I have omitted the Tirhut locality (of Bengal plants) as the so-called specimen from Darbhanga is *Momordica dioica* (in young fruit) ! Another specimen is a *Cucumis* !

Leaves with somewhat hairy petioles about as long as themselves, with peculiar oblong glandular axillary bracts. Inflorescence more or less hairy, bracts oblong. Sep. ·1″ pubescent ovate or ovate-oblong. Petals obovate. Ovary with bluntly conical tip (quite different to the beaked ovary in *Momordica dioica*). Style 3-fid half-way down with large stigmas. Seeds compressed oval ·15″ grey-black slightly scabrous.

2. **L. acutangula,** *Roxb.*, inc. L. amara, *Roxb.* Jui, *Ho.*; Paror Jhinga, *S.*; Jhinga, Ara-torui, *H.*; Tita Dhundul, *Beng.*

An extensive annual climber (very doubtfully distinct from the next species, *q.v.*) with orbicular smooth angled stems and orbicular angled or slightly 5–7-lobed leaves deeply cordate, 3–5″ both ways, minutely closely scabrous above with tubercle-based points, more softly so beneath with short hairs, the tubercles or cystoliths at base of hairs never very large, margin dentate. Tendrils 3-fid. Male flowers racemed or sometimes panicled, sometimes only 1″ long with glandular bracts near the base of the pedicel, sepals lanceolate ·3″. Fem. larger, solitary, often from same axil. Fruit 3–4·5″ clavate or pyriform, narrowed at base to a stalk often its own length, 3-celled, tardily opening by a stopple and probably not always doing so. Seeds black ·4″ flattened, elliptic, rather broader one end, which is furnished with 4 grooves and small conical points, making it much resemble a beetle with a rough thorax.

Widely cultivated and wild or feral in several districts. Fl. r.s. Fr. c.s.

Along rivers in N. Champaran is an apparently wild plant with deeply-lobed leaves and only three stamens and smooth fruits. According to the usual diagnosis this should be *L. acutangula* but it really much more resembles *L. ægyptiaca* (*q.v.*).

The unripe fruit of the cultivated plant is largely eaten as a vegetable. It is said to be demulcent, diuretic and nutritive. The seeds are emetic and purgative. The wild plant is very bitter and the fruit violently cathartic and emetic (*Nadkarni*, who calls the wild plant *L. Pluckenetiana*, a synonym).

I would have combined this and the following were it not that *L. acutangula* is probably nearer the parent species, but if combined it would be necessary to call the species *L. ægyptiaca* (the older name).

3. **L. ægyptiaca,** *Mill.* Doro, *M.*; Pulu, *Ho.*; Ghia Torui, *H.*; Dhundul, *Beng.*; The Egyptian Loofah or Towel Gourd.

A climber with very tough smooth sometimes angled stems, sulcate when dry. Leaves from orbicular to hastate-acuminate, often attaining 12″, mostly 7-lobed with very deep basal sinus, other lobes shallow or deep, denticulate, minutely gland-pitted beneath when fresh and puberulous, especially on the nerves, scaberulous above or both sides with the hair-bases developing into small hard raised discs when dried and often pubescent on the main nerves; the lobes are usually well marked and acuminate. Petiole 3–5″. Male racemes often 12–18″ long, bracts spathulate-oblong ·3″ with 1–5 large round glands nearly covering their surface. Calyx widely campanulate, hypanth. ·3–·35″ long and sepals ·5″ lanceolate, corolla sulphur-yellow, spreading, 3–4″ diam., thinly hairy. Stamens 5 or filaments connate at base in the case of two pairs or stamens 3, anthers very sinuous dehiscing on the lateral margins, filaments hairy below. Female peduncles 2–3″, calyx glandular, sepals up to ·6″, corolla 4–4·5″ diam. Staminodes on disc at base of corolla often 5, ovary appressed-villous, stigmas 3–4, 2-cleft. Fruit 6–18″ cylindrical, not angled, but with 10 darker coloured stripes. Seeds grey or black with very thin margins, smooth or with small tubercles.

Cultivated and feral in all districts. Fl. r.s. and c.s. Fr. c.s.

I have little doubt that this is but a variety of the last and that the characters given to separate the two are not at all constant.

A feral form in the Ramnagar valley has 3 stamens or 4 stamens and absolutely cylindrical fruit 4″ long. A feral smooth fruited *Luffa* in the Santal Parganas had 4 stamens. At Sidhao a similar plant in all respects to the Ramnagar plant was found except that it had 5 stamens! Sometimes 3-stamened forms easily split into 5.

The feral form has a fruit usually under 8″ long. The cultivated fruit is eaten as in *L. acutangula*. The fibrous dry mesocarp constitutes the Loofah used for scrubbing brushes, stuffing saddles and other purposes.

4. **L. graveolens,** *Roxb.*

A slender climber with a "most disagreeable heavy smell" (*Roxb.*), stems somewhat villous but glabrescent, leaves cordate broad ovate to reniform 1·5–3″ sinuate and denticulate. Tendrils 3–4-fid. Flowers yellow 1–1·5″ diam., sep. ovate. M. sub-sessile. F. short-peduncled with 1–2 sub-orbicular or oblong glandular bracts on the peduncle which is only ·2–·4″ long. Young fruit beaked, narrowly ellipsoid, when ripe oblong nearly 2″ long covered closely with soft spines and villous between, when ripe brownish-black. Seeds oval, compressed, black (*Roxb.*).

Purneah, *Kurz*! Rajmahal Hills, *Roxburgh*! It also occurs in the Sikkim Tarai, but the Chota Nagpur locality in *Bengal Plants* is, I think, an error. The only specimen (so called) from C.N. is in young fruit, and is *Momordica dioica, Roxb.*! The two can be distinguished by the tendrils, by the longer peduncle of *M. dioica* and absence of the glandular bracts and also by the broad scales and absence of villi in the latter, whereas the fruit of *L. graveolens* has narrow lanceolate scales or spines and intermixed villi. Fl. Sept.

12. THLADIANTHA, *Bunge.*

Climbing with simple rarely 2-fid tendrils. Leaves deeply cordate, denticulate. Fls. large (in our species), yellow diœcious, males racemed with often a one-fld. peduncle from same axil, bracteate or not, female peduncle elongate but only 1-fld. Hypanthium short

campanulate, the bottom shut by a horizontal scale, sepals lanceolate. Corolla campanulate 5-partite, lobes revolute about half way down. St. 5 inserted near mouth of hypanthium, anthers all 1-celled, narrow-oblong, straight. Ovary oblong, style deeply 3-fid with 3 reniform stigmas. Placentæ 3. Fruit ellipsoid baccate cylindric ribbed, with many seeds.

1. **T. calcarata,** *Clarke.* Syn. T. dubia, *F.B.I.*; Momordica calcarata, *Wall.*

A large climber with deeply cordate, neither angular nor lobed ovate leaves about 4″ by 2·5″ acute, usually villous beneath. Male racemes with serrate or inciso-serrate bracts. Female peduncle 2–3″ hairy. Flowers about 2″ diam. golden yellow. Fruit 1·5″ oblong.

Dalsingsarai, Darbhanga, *Prain's Collector*! It is common in Eastern Bengal, Sikkim and Assam. Fl. r.s. Fr. Sept.

It resembles a *Trichosanthes* superficially.

13. CUCURBITA, *L.*

Stout hispid or hairy herbs with 2–4-fid tendrils and cordate ovate angular or lobed leaves. Flowers very large yellow solitary monœcious. Hypanthium above the ovary campanulate, sepals sometimes foliaceous. Corolla gamopetalous campanulate lobed less than half-way down. Stamens inserted low down, fil. 3 short, anthers connate in a column or club with conduplicate cells. Ovary oblong, style short, stigmas large, fleshy, 3–5, often longitudinally lobed. Large epigynous cushion-shaped disc 5-lobed. Fruit a pepo. Seeds ovoid or oblong compressed smooth, margined or not.

The ovary is filled with tissue and the ovules are on large swollen parietal placentæ which meet in the axis and are recurved.

The following limitation of species is according to *Naudin* and *De Candolle*:—

A. Leaves somewhat harsh and rigid.
  L. with acute lobes, peduncles sulcate. Corolla narrowed at base with erect lobes . . . . 1. *pepo.*
  L. with rounded lobes, peduncles not sulcate. Corolla lobes curved outwards . . . . 2. *maxima.*
B. Leaves soft. Indumentum fine and soft.
  Sepals often foliaceous. Peduncle pentagonal, expanded below the fruit . . . . 3. *moschata.*

1. **C. pepo,** *DC.* Karkaru, *K.*; Konrar, Kumra, Safed-kadu, *H.*; Pumpkin,* Marrow.

A stout hispid annual with orbicular shallowly acutely lobed leaves 4–8″ diam. with soft hair between the hispidulous nerves beneath and also sometimes hispid with short bristles. Petiole 4–10″ with *rigid prickly hairs* and also pubescent. Male peduncles 4″, female 1·5″, strongly grooved in fruit. Hypanthium cupular villous with distant subulate sepals 1–2″ hispidly hairy. Corolla usually 4″ long and 4″ diam., mid-rib sometimes excurrent, ribs hairy.

The most commonly cultivated species. Fl., Fr. chiefly r.s. *De Candolle* thinks it most likely Mexican in origin.

The species includes *C. malopepo, L.*, and *C. ovifera, L.*, and shows extraordinary variety in the shape and size of the fruit, either smooth and oblong as in the

* Both vernacular and English (or American) names such as Pumpkin, Squash, etc., are often loosely applied, and to the fruit rather than to the plant.

Vegetable Marrow, pear-shaped, covered with small knobs (*Barberine*) round and depressed, dish-shaped, etc. The flesh is usually pale and scentless.

2. **C. maxima,** *Duchesne.* The Gourd, Lal Kumra (when flesh is red), *H.**

Besides the characters given in the Key it differs chiefly from the last by the absence of the prickly hairs on the petiole. The fruiting peduncle is striated but not grooved.

The fruit attains an enormous size and is usually oblong but varies in shape almost as much as does *C. pepo.* The flesh is often reddish.
De Candolle considers it to be of African origin.

3. **C. moschata,** *Duchesne.* The Musk Melon.

The species is easily recognised by its general softness, the fruiting peduncle being pentagonal and enlarged beneath the fruit which is more or less covered with a glaucous bloom. The sepals are most frequently terminated by a broad foliaceous tip and the flesh of the fruit is usually somewhat musk-scented.

Commonly cultivated ! Its native country is entirely unknown.

14. CEPHALANDRA, *Schrad.*

Climbing herbs with simple tendrils and 5-angled or -lobed or -partite leaves. Flowers rather large, diœcious, solitary, or males in abbreviated racemes, axillary white, ebracteate. Hypanthium campanulate or funnel-shaped, short. Corolla campanulate, lobed about half-way down. St. 3 with exsert connate anthers and conduplicate anther-cells. Ovary oblong, style long with 3 bifid stigmas, placentæ 3. Fruit smooth fleshy cylindric. Seeds ovoid compressed margined.

1. **C. indica,** *Naud.* Syn. Coccinia indica, *W. & A.*; Kundri, *K.*; Kanduri, Bhimb, *H.*; Ban-kundri, *Or.*; Tela-kucha, *Beng.*

Stems 5-angled, somewhat scabrous or smooth. Leaves 1·5–3·5″ rarely 4″, ovate or orbicular, variously 3–5-angled or -lobed and the lobes occasionally constricted at the base and again lobulate, but always easily recognisable by their being glabrous, delicately venose beneath but marked with numerous small round discs above, base 5-nerved and nervules usually ending in glandular distant denticulations, frequently several large circular glands near the petiole, petiole ·5–1·5″ long. Male flower solitary or 2–4 clustered on a very abbreviated rhachis. Pedicels ·3–·6″ long. Sepals spreading subulate or oblong acute ·15–·17″ long. Corolla 1–1·2″ long and 1·5″ diam. campanulate with large spreading ovate-lanceolate lobes papillosely hairy within. Stigma spreading. Fruit oblong narrowed apically or at each end, scarlet when ripe but green with usually 10 white streaks when unripe.

Common in hedges in most districts ! Also cultivated as a vegetable. Fl. Aug.–Dec. and sometimes again seen in flower in March. Fr. soon after.
A form found in the Mals of Orissa has fleshy rather glaucous leaves with the margins sparsely scabrous-ciliate.
The fruit is largely eaten.

* See note on previous page.

FAM. 72. BEGONIACEÆ.

1. BEGONIA, *L.*

Succulent herbs, often rhizomatous or tuberous, with alternate simple more or less unequal-sided palminerved leaves with cystoliths and free stipules often persistent. Flowers usually showy mostly in terminal or axillary dichasial cymes, monœcious and usually bilateral, rarely quite regular. Male perianth of two outer valvate opposite petaloid tepals and 2–0 inner smaller ones (petals ?), perianth of female of 2–5 tepals (rarely 6–8), if more than two imbricate, the outer 2 more or less covering the inner, superior. Stamens many, free or monadelphous, anthers with a large clavate connective. Ovary completely enclosed in the hypanthium, inferior, 2–4-celled with axile divided or simple placentæ, 2–4 free or partially connate styles and variously shaped stigmas. Ovules very many. Fruit usually capsular, often winged, dehiscing or irregularly breaking up. Seeds very many minute, terete or globose with reticulate testa and scanty or 0 albumen.

1. **B. picta,** *Sm.*

A pretty little plant, varying in size from one leaf an inch or two long and peduncles 4″ high to several leaves and flowering stem 18″ high. Stems hairy. First leaf radical, later usually few, bronze-green above and crimson beneath, broadly ovate cordate sometimes shortly acuminate, margin unequally dentate with teeth ending in hairs, upper surface rough with tubercle-based hairs, lower with some hairs on the nerves; in favourable localities they attain 9·5″ by 8·5″, and with a petiole 10·5″. Fls. pink, M. and F., on separate branches of the inflorescence. Larger M. tepals ·5–·7″ ovate. St. many monadelphous, yellow. F. fl. 5-tepalous, 2 outer up to ·8″. Ovary and capsule 3-winged or one wing obsolete, closely covered with crystalline branched hairs (very pretty when fresh), placentæ 2-fid.

Chota Nagpur, esp. on the plateaux on damp banks under shade, common! Sambalpur! Fl. Aug.–Oct. Fr. Sept.–Jan.

I have a field-note of a plant with 5 small white petals, but it was not collected. It may be a variety of the above.

FAM. 73. CACTACEÆ.

Succulent plants, sometimes arboreous, with columnar, club-shaped, spherical or terete, compressed or angled, ribbed or warted stems and branches, rarely as in *Pereskia*, with well-formed leaves, but leaves reduced to small subulate minute often caducous scales or subulate and fleshy with tufts of hairs, bristles, or spines in their axils.* Flowers axillary or terminal on special tubercles, usually large and showy, generally solitary, in *Pereskia* in several-fld. cymes. Perianth regular or somewhat zygomorphous, not evidently separable into calyx and corolla, rotate, funnel-shaped or salver-shaped, of many superior tepals from a tubular hypanthium. Stamens very many, inserted at various levels in the hypanthium. Ovary inferior

* The small area or cushion thus formed is here termed an "areole."

1-celled with several parietal placentæ. Ovules many anatropous with two integuments (as in most Polypetalæ). Fruit baccate 1-celled. Seeds many with curved embryo which is cylindric or club-shaped and scarcely differentiated or with two thin or fleshy cotyledons, albumen scanty or copious.

The germination of *Opuntia* (the only one I have observed) is epigeal with two normal small rather fleshy cotyledons, between which at once arises a clavate fleshy stem without intermediate more normal forms of stem.

Only the naturalised or semi-naturalised species are here dealt with; several others are found in gardens, especially epiphytic species of *Rhipsalis* with flattened 2-edged serrate branches.

I. Leaves reduced to scales.
 A. Barbed bristles 0. Stems columnar, strongly ribbed or angled. Flowers salver-shaped or funnel-shaped with tubular hyp. . 1. *Cereus*.
 B. Areoles with barbed bristles. Stems with broad flattened joints.
  Fls. rotate or funnel-shaped. Stamens not exserted . . 2. *Opuntia*.
  Fls. campanulate. Stamens far-exserted . . . . . 3. *Nopalia*.
II. Leaves well-developed. Flowers cymose . . . . . 4. *Pereskia*.

1. CEREUS, *Haw.*

Stems either erect and attaining large girth or slender and scandent with climbing roots or epiphytic, columnar in form with strong prominent ridges or angled or ribbed. Leaves reduced to scales often only developed in the earliest stages. Areoles with felted hairs with more or less numerous prickles. Flowers from the older areoles solitary, large, erect, salver-shaped or somewhat zygomorphous with very unequal spirally arranged tepals, of which the lowest often clothe the hypanthium outside the ovary, the median are calyciform and the inner petaloid. St. included or exserted from the hypanthium with long filaments. Ovules with long funicles often connate in groups on the large swollen placentæ. Berry very succulent, smooth or tubercled.

1. **C. hexagonus,** *Haw.* Bonga-daru, *K.*; Sapin, *S.*; Soju, Mal., *P.*

Stems several from the root, tall columnar with usually sharply 6-ridged stems covered with clusters of sharp spines but no barbed bristles. Fls. large solitary, funnel-shaped, white, somewhat zygomorphous.

Frequent in village hedges. Chota Nagpur! Santal P.! Puri! Balasore! Fl., Fr. May–Sept.

There is some doubt about the name as specimens and notes are both deficient. The description of *C. hexagonus* in *Britton and Rose* (*The Cactaceæ*, Washington, 1919) is as follows: Up to 15 metres high, joints 12 cm. diam. or more, short, ribs 4-7, usually 6, thin, 3-5 cm. high. Fls. 20-25 cm., tube slender, 10 cm., uppermost scales green, short, outer tepals lanceolate to oblong-lanceolate, 6-7 cm., tinged with purple, inner much thinner, white, oblong-lanc., 7-8 cm. Fruit pale red, ovoid, 5·5-13 cm., somewhat oblique.

Burkill in *Records of Bot. Surv. of India*, 1911, apparently calls this *C. pterogonus*, *Lam.*, but the habit of the latter plant is entirely different.

2. OPUNTIA, *Haw.*

Shrubs with the stems often woody, branches jointed with large fleshy and compressed limbs bearing when very young small cylindrical or subulate caducous leaves leaving axillary scars or

"areoles" from which arise very numerous fine barbed bristles and often one or more larger prickles or spines. Flowers solitary, large or mod.-sized from the marginal or apical areoles, usually yellow or reddish, regular, rotate or funnel-shaped. Outer tepals sepaloid, inner numerous petaloid. Stamens shorter than the perianth, inserted on the cupular or saucer-shaped hypanthium, of which the upper part falls off with the perianth and stamens. Ovary sunk in the hypanthium (which does not differ from the rest of the axis and bears areoles, and if broken off and planted will behave like a cutting and grow!). Ovules few or very many, enveloped by the much expanded end of the funicle.

A. Spines deciduous except one large one (rarely 2-3) on each areole . . . . 1. *monacantha.*
B. Several large spines usually remaining on each areole.
  1. Spines straight slender tawny, brown or black.
    Fls. lemon yellow changing to rose-pink . . . . . 2. *elatior.*
    Fls. orange . . . . var. *nigricans.*
  2. Spines all pale yellow, the largest stout and rarely also curved 3. *Dillenii.*

1. **O. monacantha,** *Haw.* (*Supp. Plant. Succ.*, 1819). Syn. Cactus indicus, *Roxb.*; Nagphani, *Vern.*

A large succulent jointed shrub with erect branches and with the limbs (the internode-like portions of the axis between the articulations) much compressed obovate to oblanceolate, bright-green. Areoles bearing 1–3 spines only, of which at least one is often over 1″ or 2″ long, often brown or whitish and dry-looking. Flowers yellow or only reddish outside, corolla spreading rotate, stamens yellow short, pistil longer than the stamens. Fruit green, nearly smooth.

Apparently more plentiful in the damper districts (possibly through the absence of its enemies), Purneah, Chandpur (Balasore), Cuttack and Puri, frequent! Singbhum! *Burkill** records also the following localities: Darbhanga, Muzaffarpur, Samastipur, Dalsing Sarai, Gaya (1856, *Kurz*) and Ranchi (*Wood*). Fls. chiefly in the h.s., also January, opening during sunshine.

The limbs of this species like other *Opuntias*, being branches, usually decrease in size from below upwards, so that it is difficult to give measurements, and the young ones bear small sessile subulate fleshy leaves. Outer petals smaller, obcordate, inner oblong.

This cactus is eaten by the Cochineal insect, which on introduction caused its destruction over large areas in India.

2. **O. elatior,** *Mill.* (*Gard. Dic.*, 1768), inc. O. nigricans, *Haw.* Tall Indian Fig.

Habit of last with compressed limbs of much the same shape (usually described as ovate-oblong), but frequently faintly facetted by slightly raised lines joining the areoles, somewhat glaucous. Areoles with 2–5 strong divaricate tawny or purplish-black spines. Flowers yellow soon becoming tinged with purple or outer petals red and inner dirty yellow, perianth somewhat campanulate, stamens purple, pistil shorter than the filaments (always ?). Hypanthium with tufts of bristles and a few spines. Fruit red marked with the areoles, but bristles and spines deciduous, top depressed.

Exceedingly common in the Arrah and Patna districts, *Burkill*. Purneah, *Burkill*. Very plentiful in Orissa, *Burkill*.

* *Records of the Botanical Survey of India*, 1911.

The stems become woody below with age. Leaves subulate compressed above.

Var. **nigricans,** *Haw.* (*Miscellanea Naturalia*, 1803), sp.

I do not see how *O. nigricans* is to be separated as a species from *O. elatior.* The characters given appear trivial, such as the flowers being orange (as contrasted with lemon-yellow changing to rose-pink) and the spines black. Bankipur, *Burkill.*

The Cochineal insect does not feed on it.

3. **O. Dillenii,** *Haw.* (*Supp. Plant. Succ.*). Nagphani, *Vern.*

A large straggling fleshy shrub with often drooping branches and large flat limbs, lower often longer and corky, median about 11–15″ long and only about ·3″ thick, mostly oblanceolate, articulations often with a ring of spines or bristles when young. Young leaves subulate fleshy ·2″, sub-spinulose, seated on a swollen fleshy base (petiole ?), in the axils of which are the rudimentary bristles and tomentum. Areoles finally with 5–6 (more rare only 2–4) very pale yellow spines and numerous yellow barbed bristles. Flowers entirely pale sulphur yellow or greenish-yellow or slightly tinged with red within at the base towards evening, somewhat funnel-shaped, with petals about 2″ long. Hypanthium narrowly turbinate with areoles like those on the young limbs, white tomentose but without spines or bristles (the latter sometimes present ?).

Arrah, Bankipur and Patna, *Burkill* (*loc. cit.*). A very common species about Litipara and Hirampur in the Santal Parg. ! Singbhum ! Puri, very common !

Fl., Fr. June–Sept. Flowers open in the morning and close in the evening.

Burkill gives as a distinctive character that some of the spines are always curved, "the largest stout, light horn-coloured in life, darkening in herbaria with age," but I do not often find these curved spines. He probably includes the Puri species in "*elatior*" as he does not mention *Dillenii* from that region !

It is the principal species used for fencing the Casuarina plantation on the Puri sands, and makes a thick effective hedge on sandy soil. Easily grown from cuttings.

3. NOPALEA, *S. Dyck.*

Flowers campanulate with very many tepals, the outermost scale-like. Stamens far exceeding the perianth. Ovules embraced on two sides by the long flattened funicle. The rest much as in *Opuntia.*

1. **N. coccinellifera,** *S. Dyck.* Syn. Opuntia cochinelifera, *Miller.*

Limbs fleshy obovate without spines on the areoles.

Only recorded from Shahabad (Arrah), *Burkill.*

4. PERESKIA, *Plum.*

Succulent shrubs with thick twigs and broad more or less fleshy leaves in the axils of which are areoles and clusters of spines. Flowers cymose axillary or in terminal panicles, rotate, regular, medium-sized. Tepals many free or connate, the outer usually short and fleshy green or harder and almost prickly, the inner petaloid. Stamens inserted on the margin of the saucer-shaped or cupular hypanthium which is somewhat swollen above the ovary but not produced into a tube. Ovary inferior 1-celled, or 5-celled at the top. Ovules few or many, parietal or pendulous anatropous. Fruit baccate globose or pyriform, sometimes with prickles. Seeds few, elegantly sculptured with lines. Embryo curved with the large cotyledons rolled round one another.

1. **P. bleo,** *DC.* Barbadoes Gooseberry.

A large shrub armed on some branches with long needle-like spines. L. alternate or fascicled, fleshy, narrowly-elliptic oblong acute 2-3″, shining, sec. n scarcely visible. Flowers pretty, pink, 1·5″ diam. in dense cymose panicles the ultimate branches of which resemble peduncles, with many bracts. Outer 4–5 tepals calyciform short and green, several intermediate tepals gradually passing into petals, the innermost 5-7 being distinctly petaloid ·7–·8″ long. Stamens very many with free slender filaments shorter than the petals and yellow anthers. Style long, stigma capitate deeply (about 7-) -grooved.

In gardens and hedges and almost naturalised in some parts of Ranchi. Fl. March–April and also at other times.

2. **P. aculeata,** *Plum.* The name Barbadoes Gooseberry is more correctly applied to this species. It is sometimes found in gardens and has a pair of hooked spines in each axil and white flowers. The fruit is edible.

FAM. 74. UMBELLIFERÆ.

Herbs with usually fistular stems, compound (simple in *Bupleurum* and *Hydrocotyle*) and often much dissected alternate leaves with a sheathing petiole, exstipulate or rarely stipular. Flowers small white or yellow, more rarely pink, in simple or compound umbels, 2-sexual or polygamous, rarely diœcious, regular or the outer in an umbel sometimes irregular with the outer petals larger (*radiant*). Sepals superior, usually very small or 0. Petals 5 inserted under the epigynous disc often emarginate with an inflexed tip and a median fold, imbricate or valvate and involute in bud (exc. *Hydrocotyle*). Stamens 5 inserted under the disc which is usually tumid and 2 lobed and surrounds the styles. Ovary inferior, 2-celled styles 2. Ovules 1 pendulous in each cell. Fruit 2-coccous, usually ridged and with oil-canals (vittæ)* in the pericarp. Seed 1 in each coccus albuminous. Embryo small, radical superior, cotyledons linear, often unequal or oblong.

The plane of separation of the two carpels is called the *commissure*. In the centre is a vascular system forming ultimately a distinct slender entire or forked axis (carpophore), from which the ripe carpels sometimes remain for a time suspended, but this is not always differentiated. Each coccus has normally 5 primary ridges, viz. 1 *dorsal*, 2 *marginal* or lateral, next the commissure, and 2 *intermediate*, *i. e.* one each side between the dorsal and marginal ridges. In some species there are 4 other ridges whose positions are alternate to these; they are called secondary ridges and are in a few cases more prominent than the primary.

The germination is epigeal.

Umbels simple or sessile. Leaves simple sub-orbicular . . . 1. *Hydrocotyle.*
Umbel compound (capitate in *Pycnocycla*) :—
I. Leaves entire, usually very narrow. Fls. yellow . . . 2. *Bupleurum.*
II. Leaves compound (radical rarely simple and ovate) :—
A. Primary ridges most conspicuous, vittæ in the furrows between them :—
1. Fruit narrowest at the commissure, in horizontal section didymous or laterally compressed.
Vittæ solitary in the furrows. Bracts 0 to many . . 3. *Carum.*
Vittæ 2 or more in the furrows. Bracts 0 or few . . 4. *Pimpinella.*

* The vittæ are often externally visible in the ripe fruit as dark streaks; they show under the microscope in transverse section as minute holes in the pericarp.

2. Fruit widest at the commissure, in horizontal section circular or somewhat dorsally compressed, lateral ridges, if winged, distinct, not connivent.
   a. Ridges not winged.
      i. Umbels capitate, heterogamous . . . . . 5. *Pycnocycla.*
      ii. Umbels not capitate, fls. similar or outer radiant.
         Fls. white or pink. Primary ridges strong, hairy . 6. *Seseli.*
         Fls. white or pink. Lateral ridges large corky . 7. *Œnanthe.*
         Flowers yellow. Leaves cut into filiform segments 8. *Fœniculum.*
   b. Primary ridges sub-alate or alate . . . . . 9. *Ligusticum.*
3. Fruit very wide at the commissure, much dorsally compressed, in transverse section lenticular, lateral ridges with connivent wings . . . . 10. *Peucedanum.*

B. Secondary ridges of the fruit more conspicuous or at least as strong as the primary. Vittæ under the secondary ridges, often obscure:—
   Fruit globose, smooth. Bracts 0 . . . . 11. *Coriandrum.*
   Fruit echinate. Bracts pinnatisect . . . . . . 12. *Daucus.*

1. HYDROCOTYLE, *L.* Marsh Penny-wort.

Creeping herbs with usually orbicular simple cordate entire angled or lobed palmi-nerved leaves and small scarious stipules. Fls. minute white or red in small simple axillary or sessile compound umbels, bracts usually present. Sep. minute or 0. Petals entire. Fruit strongly laterally compressed, vittæ obscure or 0.

L. ·5-2·5″ diam., not lobed. Bracts 2 (rarely 3-4) broad-ovate. Fls. few . . . . 1. *asiatica.*
L. ·25-·75″ diam., lobed. Bracts obscure. Fls. 10-15 . . . 2. *rotundifolia.*

1. H. asiatica, *L.*

A variable herb with long creeping stems rooting at the nodes, young leaves and petioles villous, never quite glabrescent. L. orbicular-reniform never lobed but often with large rounded crenatures or sometimes coarsely dentate or sub-entire. Umbels usually several at a node, perhaps representing a sessile compound umbel, each with a pair of ovate sub-amplexicaul bracts ·1-·15″ long. Fls. 3-5 rarely 6 in an umbel, sub-sessile, petals deep-red ovate acute or obtuse imbricate. Stamens red. Fr. with very narrow commissure, didymous, cocci ·11-·13″ diam. broader than long or as long, cocci with 5 primary ridges strong, sometimes with 2 or 4 of the sec. ridges also developed or the intermediate spaces venous, thinly pilose, epicarp very thick corky and endocarp thin. Seed much laterally compressed.

In wet places. Ranchi plateau! Singbhum, side of nalas in the hills! Mayurbhanj Mnts.!

The characters given above will be seen to break down the distinction of the sections of the genus given in the *F.B.I.* The species is however easily separable from *H. javanica* by the few fld. umbels, large ovate bracts and thick-walled fruits. The following varieties look very distinct superficially:—

Var. *α.* Leaves 1·5-2·5″ diam., very villous before expansion (the margins are rolled inwards in bud). Petioles 1-4·5″. Peduncles up to 1″ long. Bracts pink and pubescent when in flower. A form of this has true compound umbels with the rays ·25″ long and bracts 2-3 lanceolate-ovate! Fruit white.

Chota Nagpur! Fl., Fr. Nov.-Jan.

Var. β. Leaves under 1″ diam., less villous. Petioles ·5–1″. Peduncles 2–4 under ·5″. Fruit reddish.

Mountains of Orissa ! Fl., Fr. May.

2. **H. rotundifolia,** *Roxb.*

A much more delicate plant than the last species though somewhat resembling the last variety of that species. Leaves membranous distinctly 5–7-lobed or -lobulate with the lobes or lobules crenate; rarely exceeding ·7″ diam., with scattered short hairs beneath. Petioles ·5–1·5″ very slender. Peduncles glabrous ·1–·75″ long, 10–15-flowered with very minute bracts, flowers sessile. Fruit somewhat compressed, angled from the prominent primary ridges, glabrous, ·08″ with hard thin pericarp.

Higher hills of Chota Nagpur. Neterhat, near streams, elev. 3000 ft. ! Fl., Fr. r.s.

2. BUPLEURUM, *L.*

Glabrous with entire, often grass-like leaves and small yellow flowers in compound umbels with the bracts and bracteoles foliaceous, setaceous or 0. Sepals 0. Petals obovate, emarginate. Fruit laterally compressed somewhat constricted at the commissure with terete or sub-pentagonal cocci and distinct rarely obscure primary ridges, vittæ 1–3 between the ridges, rarely 0 or many. Seed terete, rarely slightly grooved on the inner face.

Bracts 3–5, ·15–·2″, bracteoles, exceeding the pedicels . . . 1. *mucronatum.*
Bracts 0–2 under ·15″. Bracteoles not half as long as the very slender pedicels . . . . 2. *falcatum,* var. *biharensis.*

1. **B. mucronatum,** *W. & A.*

A tall much-branched herb (up to 6 ft.) with often flexuous stem, grass-like leaves up to 6″ long often mucronate at the tip, small yellow fls. in much panicled umbels, 3–5 conspicuous lanceolate bracts ·15–·2″ long and bracteoles exceeding the pedicels and carpels. Carpels elliptic or oblong.

Higher mountains of Chota Nagpur. Sarguja, *Clarke* ! Bisrampur, *Prain's Coll.* ! Fl., Fr. Oct.–Jan.

Leaves often much attenuate towards the base and sometimes sub-obtuse scarcely amplexicaul, primary nerves between midrib and not very prominent margin 2–3 rarely 4.

2. **B. falcatum,** *L.* Var. biharensis, *Haines.*

An erect slender not much branched herb up to 3–4 ft. with grass-like leaves 5–6″ long by ·3″ broad acuminate at the tip, small yellow fls. in umbels with 1–2, or 0, inconspicuous bracts up to ·15″ long and bracteoles 4–5 lanceolate cuspidate not half as long as the ·15–·2″ long very slender pedicels. Pedicels 4–7 rather exceeding the ·15″ long narrowly oblong carpels.

Higher mountains of Chota Nagpur. Neterhat ! Fl., Fr. Sept.–Jan.

Cauline leaves slightly narrowed to the amplexicaul base with a prominent white margin and 4 primary nerves between midrib and margin.

This differs from the type which is a Himalayan plant in the short bracteoles and long pedicels, which in the type are less than half the length of the fruit.

3. CARUM, *L.*

Annual or perennial with pinnate to decompound leaves and compound umbels with few or many bracts and several to many bracteoles. Flowers white or pink polygamous, outer usually sterile often with radiant petals. Sepals small or 0. Petals retuse or emarginate. Fruit ovoid ellipsoid or oblong, laterally compressed and constricted at the commissure (didymous), cocci glabrous, papillose or muricate isodiametric, sub-pentagonal, plane on the inner face with slender conspicuous or obscure primary ridges, 1-vittate between the ridges. Seed terete or slightly dorsally compressed, plane or slightly grooved on the inner face.

A. Ovary (hypanthium) glabrous or pubescent. Rays 3–12.
  L. ternately divided, segments forked or again ternate, linear to lanceolate. Rays 3–6 glabrous. Fruit dotted or hispidulous . . . . 1. *stictocarpum.*
  As in *stictocarpum*, but fruit hispid, ·08–·1″ . . . . 2. *Roxburghianum.*
  L. 2–3-pinnate, segments linear to filiform. Rays 4–12. Ovary pubescent, fr. muricate sub-hispid . . . . 3. *copticum.*
B. Ovary very villous. Rays 18–30, villous-pubescent . . 4. *villosum.*

1. **C. stictocarpum,** *Clarke.*

A herb 1·5–2 ft. high with many slender leafy branches and 1–2-pinnate leaves with the pinnæ and their segments usually 3 only but 5 on the lower leaves, ultimate segments linear-lanceolate glabrous. Fls. minute, white or pinkish in many small umbels with usually 3–6 slender rays ·5–2″ long, rarely rays up to 12 (*Clarke*), bracts linear-setaceous to linear-lanceolate 6–8 with scarious ciliate margins. Ovary pubescent or (var. *hebecarpa, Clarke*) scarcely puberulous. Frt. under ·06″ shining yellow with microscopic dots or in var. *hebecarpa* up to ·08″ and hispidulous.

This I have found throughout the Higher Vindhyhan range from Pachmari, through the Balaghat plateau to the Mountains of Bilaspur, and it probably enters our area but has not been seen in flower or fruit there. The western form has nearly glabrous fruits but the eastern one is *Clarke's* variety *hebecarpa* which passes into the next species. Fl., Fr. Oct.–Feb.

2. **C. Roxburghianum,** *Benth.* Ajmud, *H.*

A slender plant 1–3 ft. high, much branched, the leaves cut into slender linear-lanceolate or obcuneate often lobed segments. Rays slender usually 4–5. Pedicels 6–14. Ovary pubescent. Fruit densely hispid-pubescent ·08–·1″.

Kishenganj, Purneah, *Kurz*! Fl. Sept. to March. Fr. April. Cultivated.
This, as *Clarke* says, is probably only a cultivated form of the last. It differs only in the fruit which is more distinctly ridged and more pubescent. The fruit is used in curries and as a carminative medicine.

3. **C. copticum,** *Benth.* Ajowan, *H.*

A very slender plant 1–2 ft. high minutely pubescent or glabrescent, with 2–3-pinnate leaves, the ultimate segments very slender linear or filiform. Bracts several, rarely 0, sometimes divided, linear. Rays usually about 10 slender ·5–1·5″, pedicels 6–20 more or less pubescent, bracteoles 3–5 small linear. Fruit ovoid ·08″ muricate or densely papillose-hispid, ridges usually distinct making the cocci sub-pentagonal.

Sahebganj, *Kurz*! Cultivated. Fl. Feb.-May. Fr. May.

The seeds have an aromatic smell and warm pungent taste. They are used as spices and as a carminative. *Nadkarni* states that the plant is a source of Thymol.

4. **C. villosum,** *Haines* (*Journ. As. Soc. Beng.*, xv, No. 7, pl. ix).

Stems 2·5–3 ft., pubescent, very leafy below. L. lower 2–3-pinnate and pinnatifid; upper 2-pinnate ovate, ultimate segments narrow-oblong or cuneate and lobed, minutely pubescent above, puberulous on the nerves beneath, segments or lobes mucronulate. Umbels 2″ diam., very long peduncled dense-flowered. Rays 18–30 villosely-pubescent ·5–·8″. Bracts about 10 linear ·2–·3″. Pedicels 25–30, ·1–·15″. Bracteoles about 10, ·1″ long filiform. Hypanthium densely villous. Calyx obsolete. Petals white ·03–·04″ not including the long inflexed tip, thinly pilose. Disc flattened above, 2-lobed. Styles long slender.

Sandstone Hills of Ramnagar, N. Champaran! Fl. Dec. Root rather woody and apparently perennial.

The fruit is unfortunately not known, so no Latin description of the species has yet been published.

4. PIMPINELLA, *L.*

Biennial or perennial herbs with the first year's leaves sometimes simple, cauline leaves 1–2-pinnate or decompound but sometimes simple (on the same plant and heteromorphous). Bracts few or 0, bracteoles usually linear sometimes 0. Flowers 2-sexual or polygamous. Sepals minute or 0. Petals with a long inflexed point. Fruit usually didymous, laterally compressed, ovate or ovate-oblong. Cocci terete or sub-pentagonal, plane on the inner face, ridges slender, obscure or prominent, vittæ 2–3 in the furrows. Seed with inner face plane or nearly so.

A. Leaves sub-similar. Disc 0.
 L. 3–7-foliolate, *i. e.* 3-foliolate or with one pair of 2–3-foliolate pinnæ. Bracts 0 . . . . 1. *Heyneana.*
B. Radical and sometimes lower cauline leaves 1–3-foliolate with very large ovate-lanceolate lflts. Upper different. Disc prominent.
 Rays glabrous, bracts 0 . . . . 2. *monoica.*
 Rays hispidulous-pubescent. Bracts several . . . . 3. *bracteata.*

1. **P. Heyneana,** *Wall.*

A slender erect branched herb 1–3 ft. high with glabrous striated stem and 1–2-ternately compound leaves, usually orbicular in outline. Fls. minute in leaf-opposed umbels 1·5–3″ diam. Bracts 0, bracteoles 0–1, rarely 2 setaceous, ·25″ or less long. Fruit didymous, broader than long, glabrous ridges slender, primary often pale and conspicuous when dry.

Damp places under shade, Chota Nagpur, frequent! Fl. Oct. Fr. Dec.-Jan.

Lower petioles about 2″ long. Lflts. rarely 2″ long, lanceolate or ovate-lanceolate, sharply deeply often doubly serrate, sparsely puberulous both sides. Peduncles 1·5–4″. Rays 4–14, ·5–1·5″ long with 6–10 unequal glabrous pedicels ·1–·5″. Cocci ·08″, vittæ about 8.

2. **P. monoica,** *Dalz.*

A biennial herb 3–4 ft. high with striate stems very copiously corymbosely branched. First year leaves radical 3-foliolate with

ovate-lanceolate cordate leaflets, cauline leaves of second year pinnately 3-5-foliolate, lflts. ovate-lanceolate acuminate spinulosely-serrate, upper linear with linear lobes. Umbels 1-2″ diam. very numerous terminating all the branches with small white flowers *without bracts.* Bracteoles 0-2. Frt. minutely papillose ovoid compressed ·07″ long. Carpels each with 3 distinct primary ridges with 2 vittæ between, sub-pentagonal with plane inner face.

Highest mnts. of Chota Nagpur. Ranchi and Palamau 2500-3000 ft ! Neterhat ! Fl. Nov.-Dec. Fr. Dec.-Jan.

L. glabrous or with short hairs both sides. First year's leaflets 3-5″ doubly crenate-serrate, crenatures sub-spinulose, base of leaflet often very oblique 5-nerved, petioles and petiolules long. Such leaves are occasionally found on the lower part of the stem in the second year. Upper petioles reduced to sheaths with ciliolate margin. Rays of umbel glabrous (pubescent in plants outside our area) 8-13 slender ·5-1″. Fls. ·06-·08″ diam.

3. **P. bracteata,** *Haines* (*Journ. As. Soc. Beng.*, xv, No. 7, p. 314).

A stout biennial 3-4 ft. high with striate stems branched above. First year's leaves much as in last but more pubescent and crenatures mucronate. Cauline leaves (of second year) lower 3-5-foliolate with ovate leaflets like the radical, leaflets of upper lanceolate, uppermost pinnatifid with linear-lanceolate lobes ending in sub-spinulose tips. Umbels 1-2″ diam. with about 6 linear bracts ·2-·5″ long and 3-5 bracteoles ·1-·2″ long. Fruit minutely papillose, glabrescent.

Highest mnts. of Chota Nagpur. Ranchi and Palamau 2500-3000 ft. ! Neterhat ! Fl. Oct.-Dec. Fr. Jan.

Stems and leaves pubescent or hispidulous both sides esp. on the nerves. Radical and lower cauline leaflets sometimes sub-orbicular. Lateral leaflets sometimes falcate, lateral petiolules 0-·6″. Uppermost petioles reduced to sheaths. Rays of umbel 8-12 pubescent ·5-·8′ long. Fls. ·08-·1″ diam. Pedicels ·2-·3″.

5. PYCNOCYCLA, *Lindl.*

Perennial herbs with rush-like few-leaved stems. Leaves pinnately dissected with narrow segments. Umbels short-rayed or capitate with many small bracts and bracteoles. Flowers only one perfect central in each umbellule, sessile, surrounded by several pedicelled males. Hypanthium hairy, sepals small lanceolate, often unequal. Petals obovate emarginate hairy. Fruit oblong lanceolate hairy, one carpel often abortive, surrounded by the inflated pedicels of the barren flowers. Fruit cocci with inner face deeply grooved, primary ridges filiform, vittæ numerous, very slender, scattered. Seed lunate or with a T-shaped groove on the inner face.

1. **P. glauca,** *Lindl.*

An interesting Umbellifer with woody root-stock, rush-like stems 8-18″ high (including peduncle), terete, striate and glaucous, ultimate segments of the leaves filiform sub-terete ·5-3″ long. Flowers white or purplish collected in heads resembling those of a Scabious or Composite. Heads about ·5-1″ diam. terminal on long pubescent peduncles. About 7-8 males or neuters envelope and enclose one fruit which attains about ·65″ long.

Grass lands of the Chota Nagpur plateaux. Tongo (Ranchi) *Bressers* ! Tagore's Hill (Ranchi), *Carter* ! Neterhat ! Fl., Fr. May-Nov.

6. SESELI, *L.*

Leaves 2–3-pinnate or twice 3-partite. Bracts few or many, sometimes pinnate, bracteoles several or many. Sepals minute or 0. Petals emarginate pink or white. Fruit oblong, ovate or spherical, not laterally compressed but usually widest at the commissure. Cocci with inner face plane, rarely concave, ridges strong, often hairy, vittæ one in each furrow. Disc not prominent on the fruit. Seed semi-terete.

1. **S. indicum,** *W. & A.*

A carrot-like herb with spreading and erect striate very pubescent branches from the root, 12–18″ high. Radical leaves oblong or oblong-lanceolate 4–7″ with the petiole, 2-pinnate or pinnæ pinnatisect 2–3 prs., larger 1·5″ with ovate pinnatifid pinnules and lobulate obtuse apiculate segments, cauline similar but smaller and more crisped, all hairy especially beneath with short white hairs. The fruit in this species is not always widest at the commissure, primary ridges strong, densely glochidiate.

Not common. Mahanadi River bed and other sandy places, Angul! Fl., Fr. Feb.-April.

Peduncles leaf-opposed 2–4″. Flowers white or pink ·1″ diam. in dense umbels 1–2·5″ diam. with about 15 rays, ·8″ (somewhat longer in fruit) long, hairy, bracts ·25–·3″ spreading in flower, reflexed in fruit, 8–9 linear-subulate green with scarious margins, bracteoles similar but smaller. Pet. broadly ovate with long inflexed tip.

In Upper India the ridges of the fruit are very strongly developed and *glabrous*, and so they are in *Roxburgh's* figure.

7. ŒNANTHE, *L.*

Herbs growing in wet places, sometimes creeping or stoloniferous. Leaves 1–3-pinnate. Umbels with 0 or few bracts and several linear bracteoles, sometimes radiant with polygamous flowers. Sepals small or outer m.s. Petals emarginate or with long inflexed point. Fruit glabrous, globose or longer than broad with broad commissure. Cocci semi-terete with inner face plane, lateral primary ridges large and corky, others subequal or very small or obsolete, vittæ 1 in the furrows.

More or less decumbent, stoloniferous. Peduncles 3–6″ . . 1. *stolonifera.*
Erect without stolons. Peduncles under 3″ or umbels subsessile 2. *benghalensis.*

1. **Œ. stolonifera,** *Wall.*

A glabrous herb with stout fistular more or less decumbent stems about 2 ft. long with long stolons, 1–2-pinnate leaves with sheathing bases and leaf-opposed umbels 3–4″ diam. of small white flowers. Peduncles 3–6″ long or more.

Marshy places and river banks. Neterhat 3000 ft.! Fl. May–June.

Lower leaves with 5–7 pairs of pinnæ, petioled above the sheath, upper leaves sessile on the sheath which has scarious margins, radical leaves (with petiole) about 1 ft. long, pinnæ with 3–5 leaflets; lflts. lanceolate or rhomboid-lanceolate with cuneate base, incised or serrate. Bracts 0. Rays many ·5–1·5″. Bracteoles about 9 linear, shorter than the pedicels. Calyx with 5 subulate teeth nearly as long as ovary, which is slightly laterally compressed without prominent ridges. Pet. white with a long inflexed cusp. Anthers pale pink. Inner fls. male, outer female with longer erect styles. Cocci ·12″ long. Seed terete.

2. **Œ. benghalensis,** *Benth.*

A less stout plant than the last, without stolons. Lflts. generally smaller only ·25–1″ long, of the lower leaves ovate, of the upper lanceolate. Peduncles short or 0. Rays of umbel few, about 4–6 only, usually under ·75″ long. Cocci ·1″ or less.

Sides of muddy rivers. Purneah.

8. FŒNICULUM, *Adans.*

Tall glabrous herbs with pinnately-decompound leaves, the ultimate segments linear or capillary. Bracts 0, bracteoles few small linear or 0. Sepals 0. Petals yellow emarginate with a short obtuse point. Disc large, lobes conical. Fruit oblong or somewhat ovoid-oblong, sub-terete with broad commissure, primary ridges stout sub-equal, furrows 1-vittate. Seed furrowed, flat or concave on the inner face.

1. **F. vulgare,** *Gaertn.* Syn. Anethum Panmori, *Roxb.*; Panmohari, *Beng.*; Saunf, *H.*; Fennel.

Perennial, or in India, annual, 2–3 ft. high, glaucous, with a characteristic aromatic smell, stems terete, striate, polished, almost solid. (*Roxburgh* says *not* striated as in *Dill* and *Sowa*.) Leaves divided into filiform segments, ultimate ·5–1·5″ long with no petiole above the large sheath or up to ·5″. Rays 10–25, 1–1·75″ long with 10–30 pedicels. Stamens much longer than the petals. Ovary oblong. Fruit variable in length, usually about ·2–·3″ oblong with strong ridges and a conspicuous vitta between each running the whole length of the carpel. There are also two vittæ on the inner face.

Often cultivated.

The striking, more than superficial resemblance of this plant to *Peucedanum graveolens* justified *Roxburgh* in placing them in one genus, and almost suggests that the taxonomic value of the shape of the fruit has been here carried too far in so widely separating the two species. Except in fruit the Indian *Fennel* and *Dill* more closely resemble one another than do the Indian and European Fennels.

9. LIGUSTICUM, *L.*

Perennial with 1–3-pinnate or twice 3-partite leaves, ultimate pinnæ large. Bracts 0–many, bracteoles many. Sepals 0. Petals obovate emarginate, white. Fruit ovoid or ellipsoid with broad commissure, cocci plane on the inner face, dorsally sub-compressed with very prominent primary ridges which are often sub-alate, dorsal furrows 1–3-vittate (on same plant), lateral furrows usually 3-vittate, commissure with several vittæ.

1. **L. alboalatum,** *Haines* (*Journ. As. Soc. Beng.*, xv, No. 7, p. 314).

A Parsley-like stout herb 3–4 ft. high with fistular striate stems and long-peduncled terminal umbels 2–3·5″ diam. of small white flowers giving place to whitish conspicuously 10-ridged or -winged fruit ·2″ long much dorsally compressed.

Wet places, Neterhat Plateau, 3000 ft. Fl. May. Fr. June.

Rootstock large white. Radical leaves 4–10″ long excluding the petiole which is as long, oblong-lanceolate in outline, 2-pinnate with the ultimate segments pinnatifid or inciso-serrate with linear-lanceolate lobes or teeth; pinnæ 5–7 prs. 1–3″ long,

lobes or teeth aristulate, nearly glabrous; cauline leaves often sessile on the large membranous sheaths, pinnæ with narrow segments, often lanceolate or lobed. Peduncles pubescent above. Bracts 0–2 linear. Rays over 12, hispidulous on the upper surface, ·7–1·25″ long. Bracteoles about 9 linear unequal. Petals ·05″ obovate with keeled face and inflexed tip. Pollen blue. Ovary at first somewhat laterally compressed with strong ridges. Fruit ·17″ broad, lateral ridges alate and 3 dorsal ridges sub-alate. Vittæ 1–3 in the dorsal furrows.

10. PEUCEDANUM, *L.*

Perennial rarely annual herbs with 1–3-pinnate or 1–3-partite leaves, ultimate segments lanceolate or ovate, rarely (*P. graveolens*) filiform, sometimes toothed. Rays of umbel numerous, bracts various or 0, bracteoles many–0. Fls. often polygamous, yellow (in our species) or white. Sep. 0 or small. Petals obovate, emarginate or 2-fid. Ovary glabrous rarely pubescent. Fruit much dorsally compressed, ellipsoid, oblong or orbicular, more or less winged on the lateral ridges which are closely appressed face to face, other ridges little elevated fine or obsolete, dorsal furrows 1-vittate, lateral 1- rarely 2-vittate. Seed much dorsally compressed, inner face plane.

A. Leaves cut into filiform segments . . . . 1. *graveolens* (*sowa*).
B. Leaf segments not filiform.
  1 Ovary glabrous.
    Cauline leaves pinnate, lflts. entire . . . . 2. *dhana.*
    Lower cauline leaves 2-pinnate, lflts. deeply serrate . . . 3. *nagpurense.*
  2. Ovary pubescent. Lflts. ovate inciso-serrate . . . . 4 *sativum.*

1. **P. sowa,** *Kurz.* Syn. P. graveolens, *Benth.* (in part); Anethum Sowa, *Roxb.*; Vern. Sowa, *H.*; Salpha, sowa, *Beng.*; Dill.

A graceful annual 2–3 ft. high with striated darker and lighter green stems covered with a whitish bloom and decompound leaves cut into filiform segments. Fls. yellow in umbels 1·5″ diam., often enlarging to 3·5″ diam. in fruit. Pedicels ·1–·2″ long, slender. Peduncles 1–5″.

Often cultivated. Fl., Fr. c.s.

Perhaps not more than a tropical variety of *P. graveolens*, differing only in the more delicate growth, in the fruit being somewhat smaller ·12–·14″ by ·07″, the mericarps more convex, marginal wings narrower and firmer and the ribs more prominent.

It exceedingly resembles the *Fennel* both in foliage and flower, and apart from the hypanthium and fruit good discriminating characters are difficult to define. The ultimate leaf segments are usually only ·1–·5″ long, those of *Fennel* usually ·4–1·5″ long. Hypanthium of *Fennel* in full flower ·05–·06″ soon elongating to ·15–·2″ in fruit, with conspicuous raised ribs (ridges); in *Dill* the flowering hyp. is ·02–·03″ elongating to ·12–·14″, and except the marginal wings the ribs or ridges are not obvious till the seed is nearly ripe and are then scarcely raised.

The seeds are used in medicine and in cookery.

2. **P. dhana,** *Ham.* Var. Dalzellii, *Clarke.*

A glaucous glabrous herb with flowering stems 1–2 ft., but with leaves chiefly radical 3-partite or simply pinnate with 3–5 thick oblong to lanceolate 3-nerved leaflets 2–3·5″ by ·3–·7″. Flowers small yellow in umbels with unequal and often very long rays attaining 5″ in fruit. Cocci ellipsoid ·25″–·35″ by ·25″.

High plateau lands of Chota Nagpur! Fl. March–May. Fr. May–June.

Leaflets entire (rarely toothed ?). Rays of umbel 5–10, some attaining 5″ long in fruit. Bracts 3–6 linear acuminate. Pedicels numerous. Bracteoles 4–8. Sep.

minute triangular or obsolete. Disc yellow and glandular. Fil. long. Ripe carpels compressed, usually ·25–·3″ long, broadly oblong, laterally winged, with 3 fine distinct narrow ridges on dorsal face, slightly emarginate both ends.

The typical *P. Dhana* has more compound leaves with narrower leaflets; variety *Dalzellii* is described by *Clarke* as having leaflets shortly oblong or even sub-orbicular.

3. **P. nagpurense,** *Prain.* Syn. P. glaucum, *DC.*, var. nagpurensis, *Clarke*; Epondom, oponom, *K.*, *S.*; Trio-singhi, *Birja.*

An erect stout herb 3–4·5 ft. high with a fusiform root and striate polished stems. Leaves twice ternately compound with leaflets on the lower leaves very large ovate acuminate and strongly serrate, upper lanceolate to linear and uppermost occasionally filiform. Flowers green or brownish, petals oblong-lanceolate with an inflexed tip. Cocci elliptic oblong ·3–·4″ long, broadly winged, the wings projecting both ends, dorsal ridges fine but distinct.

In the forests, frequent in the mountains of Singbhum, Palamau and Manbhum! Common in Koderma (Hazaribagh). Neterhat! Angul, *Chattarjee*! Fl. Oct.-Nov. Fr. Dec.

Leaflets of lower leaves 3-6″ long by 2-3·5″ broad, with straight or rounded or, in terminal, sometimes rhomboid base, nerves strong, tertiaries reticulate, impressed above, raised beneath. Lower petioles 8-12″ long. Umbels 2-3″ diam. in flower or 4″ in fruit, more regular than in *P. dhana*, rays about 12, ·25-1·5″, bracts 0-1 oblong with a long setaceous point, ·3″. Pedicels 14-25, bracteoles 3-4, setaceous. ·25-·3″, spreading and reflexed in fruit. Sepals short truncate mucronate. Stamens often only 2 perfect.

The stems are used for shepherds' pipes or flutes (rotu, *K.*, trio, *Birja*). The root is used as a stomachic.

4. **P. sativum,** *Benth.*, is the Parsnip, only cultivated, I believe, in the gardens of Europeans.

11. CORIANDRUM, *L.*

Only one species.

1. **C. sativum,** *L.* Dhaniya, *H.*; Coriander.

An annual slender-branched glabrous herb with a disagreeable odour, with pinnately decompound leaves, leaflets of lower leaves ovate lobed and crenate, upper linear. Flowers white or pinkish, outer radiant in compound umbels with few, 5–10, rays, bracts 0, bracteoles few filiform, sepals acute, petals emarginate with inflexed point. Fruit globose with the 4 secondary ridges on each coccus somewhat stronger than the 5 primary which are often inconspicuous wavy lines, vittæ obscure, solitary under each secondary ridge and two vittæ on the concave commissural surface; diam. of fruit about ·2″ but rather variable.

Rather widely cultivated in the gardens of Indians and often self-sown. The fruits are much used in curries. They yield Oil of Coriander which is stimulant, aromatic and carminative and is officinal.

12. DAUCUS, *L.*

1. **D. carota,** *L.* Gajur, *H.*; The Carrot.

Small country carrots are largely grown in Chota Nagpur with a white or purplish root very different in appearance from the European garden carrot, which, however, succeeds well in the cold season and on the plateau lasts throughout the hot weather.

The cocci have the four sec. ridges hispid with bristles and the 5 smaller primary with smaller sub-glocidiate hairs.

FAM. 75. ARALIACEÆ.

Trees or shrubs (never herbs in our area) sometimes scandent, often but little branched, frequently prickly. Leaves always palmately-nerved if simple, usually palmately compound or pinnate, sometimes decompound, alternate, with stipules more or less adnate to the petiole or 0. Flowers regular, small, sometimes polygamous, in dense umbels, umbels usually racemed or panicled. Calyx superior, reduced to a raised margin with sepals small or obsolete. Petals 5 or 6–7 or more, valvate or sub-imbricate, sometimes calyptrate, inserted with the stamens round or under the margin of an epigynous disc. Stamens as many as and alternate with the petals.* Ovary inferior, 2–many-celled, styles as many as the cells, distinct or united. Ovules solitary, pendulous in each cell. Fruit coriaceous or drupaceous, one or more cells sometimes suppressed. Seed pendulous, albumen uniform or ruminate. Embryo minute, radicle next the hilum.

I. Petals lightly imbricate, pedicels jointed.
  Shrubs (in our area)† with compound leaves . . . . . 1. *Aralia.*
II. Petals valvate.
  A. Albumen uniform.
    1. Ovary 2-celled. Cultivated shrub, leaves 2–3-pinnate . 2. *Panax.*
    2. Ovary 4–10-celled.
      Large climber. Leaves digitate . . . . . . 3. *Heptapleurum.*
      Small tree. Leaves palmate or digitate . . . 4. *Trevesia.*
  B. Albumen ruminate. Ovary 2-celled. Small trees.
    Leaves pinnately decompound . . . . 5. *Heteropanax.*

1. ARALIA, *L.*

Herbs, shrubs or small trees, often hairy or prickly. Leaves alternate or whorled, digitate pinnate or 2–3-pinnate with serrate or nearly entire leaflets, stipulate. Umbels variously arranged. Fls. often polygamo-diœcious. Calyx margin truncate or 5-sepalous. Petals 5 ovate, lightly imbricate in bud. Ovary 2–5-celled with 2–5 styles. Fruit 4–5-celled and -angular or subglobose and 2–3-celled. Albumen uniform.

1. **A. armata,** *Seem.*

A small very prickly unbranched tree or shrub with large 2–3-pinnate hairy leaves 2–3 ft. long with prickly rhachis and secondary rhachides. Stipules 1–2″ intrapetiolar. Lower pinnæ about 9″ long. Pinnæ about 5 pairs with subsidiary pinnæ or leaflets at their base, lowest pinnæ about 9″ long and the next higher pair somewhat longer, pinnules or leaflets softly hairy, about 6 pairs on the longer pinnæ and a terminal, ovate, caudate, 2–3·5″ long, petiolules 0–·4″.

Simlipahar Mountains in Mayurbhanj, above 3000 ft.! Fl., Fr. Aug.–Dec.

Lflts. finely serrate. Panicle often 1·5 ft. long, upper part and pedicels pubescent, bracts caducous (or 0?), pedicels ·5–·75″ unequal. Fls. about ·1″ diam. without the petals which are usually reflexed and ·1″ long, white. Fr. ·2″ long ellipsoid or subglobose, sharply 5-angled (at least when dry).

---

* Numerous in *Tupidanthus*, a small tree sometimes seen in gardens.

† The above Key is only applicable to the genera so far as they are represented in Behar and Orissa, *e.g.* *Aralia* also contains herbs and small trees and *Heptapleurum* contains large trees. The limits of the genera have, however, been very considerably changed by different authors.

Several species of so-called *Aralia* are grown in gardens for their ornamental foliage, but these plants sometimes belong to other genera. The flowers are usually greenish and insignificant from a horticultural standpoint.

2. PANAX, *L.*

Shrubs or trees with pinnate or digitate or 2–3-pinnate leaves and entire or serrate leaflets. Umbels panicled, pedicels jointed under the flowers which are often polygamous. Calyx-limb 5-toothed or nearly entire. Petals 5 valvate. Ovary 2- rarely 3-celled, styles distinct. Fruit with as many seeds as cells.

N.B.—*Panax* as here defined is the genus of that name in the *Genera Plantarum* and *F.B.I.* *Harms* in *Nat. Pflanz. Fam.*, taking the Ginseng section of *Aralia* as the true genus *Panax*, includes the Linnean *P. fruticosa* in the genus *Polyscias*.

1. **P. fruticosum,** *L.* Syn. Polyscias fruticosa, *Harms*; Nothopanax fruticosum, *Miquel*.

A shrub with 2–3-pinnate leaves and toothed leaflets. Fls. very small yellow in umbels ·3″ diam. Calyx ·04″ long, corolla caducous. Styles 3 recurved. Fr. ·15″.

Found as a pot plant in nearly every Indian verandah. Native of Java. The leaves are excessively variable. In var. *multifidum* they are decompound and very finely cut.

2. **P. cochleatum,** *DC.*, with simple often spoon-shaped leaves belongs to the genus *Nothopanax*, which is distinguished by the leaves being simple, lobed or digitate.

NOTE:—A very common plant in Indian verandahs and gardens with simply pinnate leaves and leaflets with a white margin may also be a *Panax*. I have never seen it in flower.

3. HEPTAPLEURUM, *Gaertn.*

(Schefflera, *Forst.*, Section Heptapleurum, *Harms* in *Nat. Pflanz. Fam.*)

Trees or large shrubs, sometimes scandent, without prickles. Leaves digitate with coriaceous entire or sub-entire leaflets, rarely uni-foliolate or twice digitate. Umbels panicled or in branched racemes, bracts woolly, pedicels not jointed under the flower. Flowers 5–10- usually 5–6-merous (including the carpels). Style very short clavate or scarcely developed, the broadly conical top of the ovary being apparently stigmatic. Fruit sub-globose, 5–6-angled. Seeds compressed, albumen uniform.

1. **H. venulosum,** *Seem.* Syn. Schefflera venulosa, *Harms*; Sukriruya, Sukrirun, *K.*; Sunumjur, *S.*; Ban-simar, *Beng.*; Jari, *Or.*; Saprunia (Bonai, *Cooper*).

A large climbing or epiphytic shrub attaining 3 ft. girth with digitate 5–7-foliolate leaves and yellow flowers in panicled umbels.

Climbing on trees and rocks in the more humid parts of the province or in the mountainous districts, frequent. Throughout Chota Nagpur ascending to the top of Parasnath! Santal Parganas! Puri! Mayurbhanj! Bonai, *Cooper*! Angul, common! Sambalpur! Fl. May–June. Fr. r.s.

Clarke says (*Journal L.S.*, xxi, 252): "I noticed that *Heptapleurum* commences its life here (*i.e.* Parasnath) as a scandent epiphyte, but subsequently reaching the ground, it grows to a large size as a tree, and shows no signs of its early history."

Lflts. unequal 2-6″ by 1-2″ elliptic-oblong acuminate glabrous rather coriaceous, sec. n. 3-4 rather strong but not much stronger than intermediate, tertiaries reticulate. Petioles 3-12″. Petiolules 1-4″ long. Stipules connate within the petiole. Panicles glabrous. Umbels ·3-·4″ diam. racemed on the 5-8″-long branches of the short panicle. Bracteoles 0. Calyx truncate. Petals 5-6, 3-nerved. Style 0.

Var. **Roxburghii.** Syn. Schefflera Roxburghii, *Gamble*; Aralia digitata, *Roxb.*

This is distinguished from *H. venulosum* by the less leathery leaves, main nerves scarcely more prominent than the secondary and reticulations, not very oblique, about 60 degrees with the midrib, panicles with a rather long rhachis (*Gamble*), whereas *venulosa* has the main nerves far the most prominent, very oblique, about 30 degrees with the midrib, panicles with a short rhachis (teste *Gamble*).

Perhaps also the petals are more caducous and narrow-oblong compared with the ovate petals of *venulosa*, but although one of the two species or varieties is very common, neither has been sufficiently collected to indicate their relative distribution. A specimen from Parasnath summit has been named *Roxburghii* at Kew. Its leaflets are broadly elliptic and venulose.

4. TREVESIA, *Vis.*

Shrubs or small trees, often prickly and sometimes stellately hairy. Leaves palmate or digitate or the petiolules united by a foliaceous wing, stipules intrapetiolar or obsolete. Flowers polygamous, rather large for the family, in panicled umbels. Calyx-margin entire or toothed. Flowers 8-12-merous, ovary with as many cells as the petals, styles united into a small boss or short column. Fruit ovoid. Seed compressed, albumen uniform.

1. **T. palmata,** *Vis.*

A small erect scarcely-branched soft-wooded prickly tree 10–20 ft. high with the young parts covered with a reddish tomentum. Leaves large sub-orbicular, palmate with the leaf lobes deeply gashed or with sharp lanceolate lobules which are rather shallowly serrate. Flowers white in large drooping panicles composed of numerous umbels 2–4″ diam.

Valleys north of Bettiah and in the Ramnagar Hills! Purneah, near the northern boundary! Valleys in Singbhum (*e.g. Jui gara* in the Leda Forest), very rare! Fl. Jan.-March. Fr. May-June.

Leaves 1-2 ft. diam. with cordate base, divided about or rather more than half-way down into about 9 lobes, beneath with stellate tomentum gradually glabrescent. Petioles 2-3 ft. prickly towards base. Panicles 18″ long. Bracts about 1″. Fls. 25-40 in an umbel, buds ·4″ diam., the ribbed corolla 8-10-petalous often calyptrate, calyx with wavy margin. Peduncles of umbels attain 4″. Fruit broadly oblong-ovoid, truncate or sub-globose, ·65″ diam., ribbed when dry.

5. HETEROPANAX, *Seem.*

An unarmed small tree with very large pinnately decompound leaves and large panicles with the umbels racemose on the branches, bracts small ovate persistent, pedicels not jointed under the flower. Fls. polygamous, calyx-margin nearly entire. Petals and stamens 5. Ovary 2-celled with 2 distinct styles. Fruit much laterally compressed, 2-seeded. Seeds compressed, albumen ruminated.

1. **H. fragrans,** *Seem.* Rengebanam, *K.* (the name given to Oroxylum indicum, which it superficially resembles).

An erect small tree up to 2 ft. girth with enormous tri-pinnate leaves 3–4 ft. long and 2–3 ft. across, elliptic or ell.-ovate glabrous entire leaflets 3–7″ long, or the terminal attaining 9″ by 4·5″. Flowers small yellow in umbels racemed on the branches of an erect panicle 18″–2 ft. long which is covered with a deciduous rusty stellate scurf or tomentum. Fruit closely resembling that of an Umbellifer but not splitting into mericarps, strongly compressed at right angles to the septum, ·4″ diam.

Rather frequent in the more humid districts or among mountains. Champaran! Chota Nagpur, frequent in valleys near streams and on the cool sides of hills! S.P., very common on north aspects on the trap of the Rajmahal Hills! Angul! Fl. Dec. Fr. Feb. Evergreen.

The pinnæ are sometimes 4-5-nate together with a single leaflet at the nodes of the main leaf rhachis. Lflts. 1–7 on the ultimate pinnules with base usually somewhat oblique and rounded, apex shortly acuminate. Styles spreading.

Var. **serrata,** *Haines.* Lflts. ovate-lanceolate caudate, sharply, almost sub-spinulosely, serrate. Bark rugose, blaze soft white with indistinct spots.

Near streams in the mountains, Southern Range, Palamau!

FAM. 76. CORNACEÆ
(Tribe Alangioideæ).

Trees or shrubs, sometimes thorny, with alternate entire or lobed often palmately-nerved exstipulate, sometimes gland-punctulate leaves. Flowers white or cream-coloured, regular, 2-sexual in axillary fascicles or cymes. Calyx superior, usually feebly developed, reduced to a marginal rim on the hypanthium or with 4–10 teeth. Petals 4–10 linear or somewhat lanceolate, valvate in bud, free or somewhat connate at the base. Stamens epigynous as many as the petals or 2-4-times as many, sometimes adnate and inserted with them between the calyx-rim and the disc at the base to the petals, connective elongate and anthers narrow adnate. Disc epigynous swollen. Ovary completely inferior and adnate to the hypanthium 1–2-celled. Style inserted in the middle of the disc, with usually 2-seldom 3-lobed stigma, the lobes lobulate at the margin. Ovule 1 pendulous from the top of each cell, compressed, micropyle superior usually lateral. Fruit a drupe crowned by the calyx usually 1-seeded. Seed with thick testa and fleshy albumen, cotyledons foliaceous palmately-nerved, thin with cordate base, radicle long terete.

1. ALANGIUM, *Lamk.* (including Marlea, *Roxb.*).

In the *F.B.I. Marlea* is separated from *Alangium* by the characters of having stamens equalling the number of petals and by the flat cotyledons, whereas the cotyledons of *Alangium* were said to be crumpled and the albumen ruminate. As noted in my *Flora of Chota*

Nagpur the cotyledons of *A. Lamarckii* are flat and the albumen *not* ruminate and I therefore follow *Harms* in bringing our species of *Marlea* under *Alangium*, the characters of which are as above.

Leaves oblong or elliptic. Fls. fascicled . . . . . 1. *Lamarckii*.
Leaves broad, often lobed. Fls. in cymes . . . . . 2. *begoniæfolium*.

1. **A. Lamarckii,** *Thw.* Syn. A. hexapetalum, *Lamk. & DC.*; Ankol, *K.*; Dhela, *S.*, *Kharw.*; Akola, *H.*; Ankula, Dolanka, *Ur.*; Akarkanta, *Beng.*; Kumri, *Mal P.*

A bushy tree, usually small and thorny, with oblong, oblong-lanceolate, or elliptic leaves 3–6″ by 1–2″ pubescent all over when young. Flowers m.s., white in axillary fascicles or from the axils of fallen leaves with 5–10 petals ·5–·9″ long, recurved or revolute after expanding. Stamens 20–30 very villous below. Fruit ·3–·75″ sub-globose or ellipsoid, black, succulent with bony endocarp, crowned by the calyx, appearing ribbed when dried.

A common tree but rather locally abundant. It prefers the well drained sides of nalas but is often found in waste ground. Champaran, in mixed forests near rivers! Extending south and south-east to Monghyr and Santal Parganas! Common in Chota Nagpur! Puri! Mayurbhanj! Angul! Orissa States, common, *Cooper*! Sambalpur, local! Fl. March–May. Fr. June–July. More or less leafless at the time of flowering. New leaves appear May–June. Some trees are very beautiful when covered with their masses of sweet-scented flowers, others flower sparsely.

Attains 4 ft. girth in favourable localities (near rivers) but no great height, rarely 30 ft. Bark light-coloured, somewhat flaking, blaze cream-coloured. Leaves with sometimes unequal base which is 3-nerved or the first pair of sec. n. is close to the base, other sec. n. about 5 and tertiaries more or less parallel, upper surface with pubescent nerves, beneath sparsely hairy and with gland pits or tufts of hair in the nerve axils; when fresh the leaf is also minutely pellucid-punctulate. Petiole ·25″. Hypanthium usually broadly cup-shaped in flower with 5-6 pubescent teeth. Cotyledons with 3-nerved base.

In Monghyr is a form with leaves over 6″ long and ovate-lanceolate, very pubescent beneath.

Dhelha wood is strong and is much used for agricultural implements. The bark and root are used in jaundice, the seed for the cure of boils (in Sambalpur). The fruit is eaten.

2. **A. begoniifolium,** *Harms.* Syn. Marlea begoniæfolia, *Roxb.*; Timil, Akhani, *Nep.*

A small thin-crowned tree with spreading long branches on which the large leaves are often distichously arranged. Leaves ovate and entire to sub-quadrate and with large lobes, 4–8″ long, young villous, old glabrous or nearly so above, pubescent on the nerves beneath and with tufts of hairs in the nerve axils, basal nerves 3–5. Flowers cream-coloured in 2-chotomous cymes 2–3″ long. Calyx minutely toothed, petals 6–8, stamens as many with short stout very villous filaments and long anthers. Fruit broadly ellipsoid ·3″, not ribbed when fresh, seed slightly grooved, ·25″, black on both faces with a lateral white band.

Northern Purneah! Fl. June. Fr. Aug. Decid. Jan.-March.